CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
34 B. STRANDVEJ, HELLERUP. — DANEMARK

RAPPORTS
ET
PROCÈS-VERBAUX DES RÉUNIONS

VOLUME C

2ÈME PARTIE

RAPPORT ADMINISTRATIF

(1935—1936)

EN COMMISSION CHEZ
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NOTICE

The annual Procès-Verbaux des Réunions will be issued in three parts under the same volume-number:

1° Report of Proceedings at the annual Council Meeting,

2° Administrative Reports for the past year, and

3° Appendices to reports and proceedings, i. e., minor reports to administrative reports and papers read at Committee meetings.

Each part will be published separately and issued as soon as possible.

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Copenhague — Imprimerie Bianco Luno A/S.

REPORT

of

ADMINISTRATION 1935—1936.

(May 2nd, 1936).

I. General.

Composition of the International Council for the Exploration of the Sea.

The composition of the International Council has not been subject to changes in respect of adhering countries during 1935—36, and the Delegates so far announced for the coming meeting are those appointed last year.

The current 5-year period of adhesion expires on July 21st 1936, and the Governments have been approached through the Danish Foreign Office as to a continued co-operation. The Governments of the following countries have replied and renewed the promise of co-operation for a further period of 5 years as from July 22nd 1936 to July 21st 1941: Belgium, Denmark, Finland, France, Germany, Great Britain, Holland, Irish Free State, Norway, Poland and Sweden. No replies have so far been received from the Governments of Portugal and Spain. The Latvian Government has asked to become a full member of the Council and this request has been placed before the Governments of the adhering countries through the Danish Foreign Office for their consent in accordance with Article 2 of the Statutes of the Council.

Composition of the Bureau.

No change as to the composition of the Bureau has taken place during the past year, and the Bureau thus consists of: — Mr. H. G. Maurice, President; Professor Johan Hjort, M. Théodore Tissier Dr. C. Heinrici and Professor Martin Knudsen, Vice-Presidents; — Professor Otto Pettersson is Président D'Honneur with the right to attend meetings of the Bureau.

Committees.

A list of Committees will be found in the Procès-Verbaux of the last Council Meeting. These Committees remain in being and the only change so far announced is caused by the retirement of the Danish Director of Fisheries, Mr. F. V. Mortensen, who has been replaced on the Statistical Committee by Mr. A. Strubberg.[1])

Audit of Accounts.

The Accounts of the Council for 1934—35 have been audited by a qualified Accountant and examined and found correct by the Finance Committee. The Accounts will be submitted to the Council for final approval.

The Accounts for the year 1935—36, it has not been possible to finish for an audit prior to the meeting. A preliminary account, therefore, is given overleaf and will be put before the auditors soon after the meeting. The Income and Expenditure Account as compared with the Estimates does not give rise to any special remarks; item VI, Printing and Distribution, is the only one that differs to any appreciable extent from the Estimates, but this is due to the facts mentioned below under the heading "Publications": postponed and relinquished publications. Also in respect of the Faune Ichthyologique the grant of 8,000 Kroner stand against an amount of Kr. 37.86, due to the fact that pressure of other work has made it impossible this year to complete the first set of sheets.

The increase of the Pension Fund amounts to Kr. 4,453.44, derived from Kr. 3,500 carried from the

[1]) Further changes announced during the Council Meeting will be included in this year's list.

Preliminary
Income and Expenditure Account for the year ending March 31st 1936.

EXPENDITURE

		Estimates	Expenditure	
	I. Incidentals			
1	President	*17,000.00*	6,000.00	
2	Chairman of Editorial Committee		2,000.00	
3	Hydrogr. Consultant		3,000.00	
4	Editor of Statistics		2,000.00	
5	Editors of Journal		4,000.00	
				17,000.00
	II. Headquarter Staff			
6	Adm. Secretary	*10,000.00*		10,000.00
	Clerical Staff			
7	1st Asst. Secretary	*20,000.00*	6,000.00	
8	2nd — —		5,000.00	
9	Statistical —		4,800.00	
10	1st Auxiliary Assistant		2,400.00	
11	2nd — —		1,770.00	
				19,970.00
	Hydrographic Staff			
12	Hydrographer	*9,000.00*	3,000.00	
13	Hydr. Secretary		3,000.00	
14	— Assistance		2,400.00	
15	Clerical Secretary		600.00	
				9,000.00
	III. Office Expenditure			
16a	Rent	*14,000.00*	4,500.00	
b	Light and Heating		1,390.85	
c	Stationery, Books, etc.		2,294.79	
d	Teleph., Telegr., Postage		1,325.25	
e	Furniture and Fittings		521.85	
f	Insurance		188.15	
g	Upkeep, Cleaning, Rep.		1,917.55	
h	Miscellaneous		1,548.96	
				13,687.40
17	**IV. Travelling Expenses**	*16,000.00*	9,294.55	9,294.55
18	**V. Chairmen of Committees**	*31,000.00*	31,000.00	31,000.00
19	**VI. Printing and Distribution**	*41,000.00*		32,960.57
	Ordinary Expenditure	*158,000.00*		142,912.52
	VII. Extraordinary Expenditure			
20	Cost of production of Faune Ichthyologique	*8,000.00*	37.86	37.86
	VIII. Pension Fund			
21	Transferred according to Standing Resolution	*3,500.00*	3,500.00	3,500.00
22	Refund of Pensions	*9,500.00*	9,500.00	9,500.00
	Total Expenditure	*179,000.00*		155,950.38
	Excess of Income over Expenditure			10,735.06
				Kr. 166,685.44

INCOME

		Estimates	Income	
	I. Annual Contributions[1]			
	Participating countries:			
	France 1935—36	*20,000.00*		
	Germany $^{16}/_{4}$ 36 —	*20,000.00*	20,000.00	
	Great Britain —	*20,000.00*		
	Spain —	*20,000.00*		
	Belgium —	*10,000.00*		
	Denmark $^{25}/_{1}$ 36 —	*10,000.00*	10,000.00	
	Holland —	*10,000.00*		
	Norway $^{23}/_{4}$ 36 —	*10,000.00*	10,000.00	
	Poland $^{18}/_{3}$ 36 —	*10,000.00*	10,000.00	
	Sweden $^{15}/_{8}$ 35 —	*10,000.00*	10,000.00	
	Finland —	*5,000.00*		
	Irish Free State $^{21}/_{3}$ 36 —	*5,000.00*	5,000.00	
	Portugal —	*5,000.00*		
	Other countries:			
	Latvia $^{28}/_{3}$ 36	*2,000.00*	2,000.00	
		157,000.00		67,000.00
II.	Outstanding as per $^{2}/_{5}$ 1936			90,000.00
III.	Interests on Bank Deposits	*1,000.00*	1,634.11	
	Interests on Investments	*6,000.00*	6,000.00	
		7,000.00		7,634.11
IV.	Sale of Publications	*2,000.00*		2,051.33
	Kr.	*166,000.00*		

[1]) The dates after the name of the country indicate the date of the payment received.

Kr. 166,685.44

Statement of Pension Fund Accounts 1935—36.

EXPENDITURE		INCOME	
Mrs. Drechsel's pension	6,500.00	Balance as per April 1st, 1935	39,018.60
Capt. Schøning's pension	3,000.00	Transferred from revenue	3,500.00
Balance as per March 31st, 1936	43,472.04	Refund of pensions paid	9,500.00
		Interests	953.44
Kr.	52,972.04	Kr.	52,972.04

Preliminary Balance Sheet 31st March, 1936.

LIABILITIES			ASSETS		
Capital Reserve:			Cash at Bankers	16,127.56	
Balance per April 1st, 1935	237,839.38		— - Savingsbank	680.43	
Excess of Income over Expenditure	10,735.06		— in hand	624.34	
					17,432.33
Balance as per March 31st, 1936		248,574.44	Danish Treasury Bonds (nom. value Kr. 120,000; market value on March 31st, 1936, Kr. 123,600) at cost		118,543.43
Pension Fund		44,739.54	Pension Fund:		
Sundry Creditors as per March 31st, 1936		8,051.85	Cash at bankers	534.81	
			Danish Treasury Bonds (nom. value Kr. 43,700; market value on March 31st, 1936, Kr. 44,378) at cost	44,204.73	
					44,739.54
			Sundry Debtors as per March 31st, 1936		120,650.53 [1]
Kr.		301,365.83	Kr.		301,365.83

[1]) Furthermore Rbl. 14,430.54 (Russian Contr. 1914/15) deposited in a Leningrad Bank from which it has not yet been possible to withdraw it.

expenditure account and Kr. 953.44, interests of capital. The excess of Income over Expenditure amounts to Kr. 10,735.06. The total capital of the Council including the Pension Fund thus amounts to Kr. 293,313.98 as against Kr. 276,857.98 last year.

Meetings.

Meetings of the Bureau were held in June 1935 and March 1936. All members of the Bureau and the Administrative Secretary were present at both meetings with the exception of Professor Martin Knudsen who was prevented by illness from attending the latter meeting, when also the Honorary President, Professor Otto Pettersson, was in attendance.

Special Meetings were held in accordance with the Council's decision of last year (see Rapp. et Proc.-Verb., Vol. XCIV, 1 p. 15): (1) in Lowestoft on October 16th—17th and (2) in Copenhagen on December 4th—5th. The reports of these meetings are appended to this report and will be found on p. 7.

II. Work of the Office in Copenhagen.

The ordinary administrative work, correspondence etc. has been carried out on the customary lines. The usual statements as to publications, hydrographical and statistical departments are given below.

In course of the year the bibliography published in the Journal du Conseil has been arranged alphabetically according to authors in loose-leaf books and this record is brought up to 1934; this work will be continued and the index will be kept up to date as and when new bibliographical lists are published. As and when time permits a subject-index will be prepared also.

In accordance with a decision of the Consultative Committee of last year (Rapp. et Proc.-Verb., Vol. XCIV, 1 p. 21 and 39) a Central Index of Fish Marking Experiments has been established and contains at present all fish marking experiments made since 1920 on the instigation of Danish researches and made within the Transition Area, the North Sea and the Atlantic and Greenland waters. Further, arrangements have been made with various laboratories and biological stations from which records of fish marking experiments are already being posted to this office for inclusion in the Central Index. In addition hereto a Central Index Department has also been established containing records of Plankton hauls, Young Fish Trawl and Egg-net hauls; Fish Measurements, Age Determinations and Racial Investigations as well as a C.I.D. for Bottom Samples. This Index covers at

A. Publications.

Report regarding publications issued and cost of same during the financial year 1935—36.

Series	Volume	Pages	Subject	Estimated	Cost
Rapp. &	XCIV	(240) 218	Procès-Verbal, Rapport Administratif et Appendices	*6,000*	4,983.07
Procès-Verbaux	XCV	(64) 62	Report of Special Meetings	*1,200*	1,261.04
—	XCVI	(36) 38	Laws and Regulations concerning Salmon and Trout Fisheries	*600*	792.87
—	XCVII		Guide to scale-reading of Samonid fishes	*1,500*	1,945.39
—	XCVIII	72	A Review of Fishery Statistics in Relation to Wholesale-Index	*1,500*	1,986.05
—	XCIX	(100) 120	North Western Area Report	*2,500*	2,757.77
Bulletins		121	Bulletin Hydrographique 1934 ..... Kr. 5,652.50 less 20 pp. published at the cost of the Woods Hole Oceanographic Institution. — 800.00	*4,000*	4,852.50
—			Thermograms	*200*	450.55
—			Bulletin Statistique 1933	*2,200*	1,703.27
Journal du Conseil	X, 1—3	368		*8,000*	6,234.07
			Miscellaneous	*800*	642.50
			Total...		27,609.08
			Translations	*2,000*	1,235.75
			Registration of Hydrographic data		1,805.50
			Distribution	*3,000*	2,310.24
			Grand Total Kr....	*33,500*	32,960.57

present all Danish investigations since 1902 up to date with a few exceptions only for the last two years; it is intended to continue with the work of other countries next year. The C.I.D. will be on view during the meeting for the criticism of Experts and for advice as to continuation.

Premises.

The present premises of the International Council will have to be evacuated by the end of October this year and new premises have been offered by the Danish Government at the Charlottenlund Castle as from the date of removal. The new premises will permit of the necessary extension of space at a rent slightly above that paid to-day.

Publications.

At the last sitting of the Council a comparatively extensive programme of publications was adopted, but only part of this programme has been carried out during the past year. Thus, the annual report of the Atlantic Slope Committee has been relinquished owing to lack of material, the publication of Matthews's Tables and of the Transition and Baltic Area Report have been postponed until next year, the manuscript of the former not being quite ready yet, while that of the latter was not complete by the end of this financial year.

The reports of the special Plankton Meeting and the special Hydrographical Meeting last year were not issued until April this year, owing to lack of one of the manuscripts until March. The work on other reports, viz: North-Western Area Report, Laws and Regulations of the Salmon Fisheries, Guide to Scale Reading of Salmonoid Fishes and Review of Fishery Statistics in Relation to Wholesale Index, have been highly delayed because the manuscripts of these reports were not ready until the beginning of 1936, and the latter 4 publications as well as that of the Scientific Meetings last year have, therefore, appeared as late as March and April 1936. Other publications of the year do not give rise to special remarks except the Faune Ichthyologique which it was decided last year to bring to an end with three covers containing 24 sheets each. This publication is in hand, but owing to work with the above mentioned publications and the many reports for the early Council Meeting it has been impossible to further the issue of any one of the said sets of sheets. Cover No. 16, therefore, will not appear until the early summer. It is hoped to have this publication finished before the end of the coming financial year.

Hydrographical Department.

The usual work of reporting meetings has been carried out as in the previous years by the Hydrographer and his Secretary, while the routine work has been carried out by mutual assistance of the administrative and the hydrographical staff; it concerns the issue of the Bulletin Hydrographique, the preparation of separate lists of observations and of redrawing and duplicating of thermograms.

Thermograms have been received as last year from Norwegian liners and have all been redrawn and copied for quick reproduction as and when required. — The hydrographical material arranged in sections or by routes have been retyped on special lists for quick reproduction on light-sensitive paper and are

now arranged in such a way that a copy of any section can be dispatched without delay from the Central Office as and when required.

The Bulletin Hydrographique for 1934 has been published and contains some 48,000 observations as against 45,000 last year and 41,000 in 1932.

Further reference to the work of the Hydrographical Department will be found in the Administrative Report of the Hydrographical Committee where also an index of hydrographical observations, published in the Bulletins Hydrographiques since 1902, is mentioned. This index is carried as far as 1924 for the entire Atlantic and will be finished, as to observations published within the publications of the Council, in a few months time.

Samples of sea-water have been received for control analyses from the Aquarium Vasco da Gama, Dafundo (6 samples) and from the Department of Lands and Fisheries, Dublin (13 samples).

The Hydrographer has been engaged on correspondence with members of the Sub-committee for the Consideration of Nomenclature and a preliminary report will be found on page 91.

Statistical Department.

The Bulletin Statistique for the year 1933 was published in December 1935. The work on the Bulletin for the year 1934 is well in hand, but statistical data are still missing from a few countries.

MEETING OF HERRING EXPERTS

Held at the Fisheries Laboratory, Lowestoft, England, October 16th—17th, 1935.

Convener: Mr. F. M. Davis.

Terms of reference.

"Co-ordination of the results of Herring research" (Combined North Sea Committee, 1935, II. 2).

Agenda issued with convener's notice.

"The present state of knowledge concerning the origin and distribution of herring populations in western European waters".

Detailed Agenda.

1. Election of Chairman.
2. Opening remarks.
3. Discussion of Professor J. le Gall's "Le Hareng. Les populations de L'Atlantique Nord-Est" (of which a précis has been circulated).
4. Decisions as to
   a) Which herring populations in the area may be accepted.
   b) On which populations further researches are required.
5. Recommendations as to future work.
6. Any other business.

Representatives attended from the following countries. A list of those who took part in the discussions or circulated memoranda is to be found in Annexe A.

Belgium	Iceland (by invitation)
Denmark	Irish Free State
England	Norway
France	Scotland
Germany	Sweden
Holland	

Previous to the meeting the experts circulated through the convener memoranda on the population question, as regard the areas covered by their respective researches. These memoranda are to be found in Annexe B.

Proceedings.

1. Mr. F. M. Davis was unanimously elected chairman.

2. In his opening remarks the chairman stated that he had reduced the scope of the terms of reference, because he considered that it was only possible in the time at the disposal of the meeting to deal with a limited section of herring research.

He considered that a discussion of Professor Le Gall's paper would give a concrete foundation for the deliberations of the meeting.

He stressed his personal view that the causal factors, whether hereditary or environmental, that influenced the socalled "racial characters" of self-contained biological herring communities were a matter of secondary importance. The biological communities undoubtedly existed, and the important point was to be able to isolate and define them.

3. A discussion on Professor Le Gall's paper took place. The meeting was then resolved into three sub-committees, selected on the basis of Le Gall's "Atlantic", "Coastal" and "Brackish Water" population areas.

The conclusions and recommendations of these committees were, on the second day, submitted to the meeting, and form the basis of the conclusions and recommendations of the meeting.

4. The conclusions of the meeting were agreed.

5. The recommendations of the meeting were passed.

6. Professor Gilson demonstrated a chart, printed by the Royal Museum at Brussels. This chart covered the intermediate area between the southern North

Sea and Eastern Channel, and was printed along with seven sections across this area.

Professor GILSON stated that the Royal Museum had decided to print a large number of copies of the chart to be delivered to the Central Bureau in exchange for the publications of the Council, and the Secretary would present centres of research with as many copies as they might require for the purpose of recording any investigations made in the area.

The meeting considered that the use of these charts would be very helpful in recording data obtained on herring populations in this area.

There was no other business within the scope of the meeting.

The meeting then terminated with a vote of thanks to the chairman.

Conclusions.

1. It is considered practical for the present to include all herring living along the Atlantic Slope and the Norwegian Sea (areas Ireland, West Scotland, Norway and Spitzbergen, Faroes, Iceland to West Greenland) in a single main group under the name ATLANTIC HERRING.

Characteristics (Vert. S. 56.90—57.56. K_2 13.3—14.5).

Our knowledge of the different populations is at present insufficient to justify a definition of the separate spawning communities (biological groups) or populations with the exception of the "spring" spawning Scottish herring referred to in IV below.

2. The herring of the North Sea and Channel area may be divided into four natural groups, namely:

I. The "autumn" spawning herrings of the North Sea.
II. The "winter" spawning herrings of the southern North Sea and Straits of Dover, which, it is recommended, shall in future be known as the DOWNS HERRINGS.
III. The "winter" and "spring" spawning Channel herrings.
IV. The "spring" spawning Scottish herring.

I. THE AUTUMN SPAWNING NORTH SEA HERRING.

These autumn spawning herrings which mature in their third or fourth year may be considered as a natural group made up of possibly three sub-groups, one of which spawns on the east side of Scotland, the majority within 40 fathoms, from July to September, another which spawns on the English coast between September and October, and a third which spawns on the Dogger Bank from September to November. The average number of vertebrae of the first sub-group varies between 56.3 and 56.5; K_2 approximately 14.8.

The limits of this main group according to the places of spawning are 60°20′ in the north and approximately 53° in the south. It is possible that the herrings which spawn on the Jutland Bank and on the tail end of the Dogger belong to this main group, and it must not be overlooked that there is possibly a relationship between the autumn spawning herrings in the Kattegat and these fish.

II. THE DOWNS HERRING.

These herrings spawn from October to the end of January on the Thames Banks, Flanders Banks and along the French coast from Griz Nez to Antifer. It is recognised that in this area two or more morphological types of spawning herrings are met with.

III. CHANNEL HERRING.

These herrings spawn from December to March or April inclusive and the extent of their spawning is purely "local". The main spawning places may be described as being from Start Point to Dodman Point and on a line from Dodman Point to Barfleur. This group of herrings has 56.7 to 56.9 vertebrae.

It is possible that the Smalls herring are allied to some extent to this group. These fish are a mixed stock of spring spawning and autumn spawning fish.

IV. THE SPRING SPAWNING SCOTTISH HERRING.

The spawning of these fish begins in early February and continues until the middle of April. The herrings are fairly uniform in character except in the Firth of Forth. Their average number of vertebrae is 57.0 to 57.2 and their value K_2 is 13.8 to 14.2. Their spawning grounds are the Viking Bank, N.W. Shetlands and N.W. Scotland, including the entrance to the Clyde estuary but not inside the estuary.

FIRTH OF FORTH SPAWNERS: There are great differences in Vert. S and K_2 in these herrings even in the same year-class. They constitute a complex mixture of spawners but there is evidence to show that one component at any rate is of northerly origin.

FLADEN GROUP: On the Fladen ground there exists a mixed stock of spring and autumn spawners and one other (possibly late autumn), but these latter, it appears certain, do not spawn on the Scottish coast.

3. The "autumn" herring communities of the Kattegat spawn in the area but seem to some extent to migrate to the Skagerak and probably even to the North Sea after spawning.

The big spring spawning herring of the Skagerak and the Kattegat spawn in these areas and seem to be closely related to the Norwegian spring spawning herring.

4. In the Baltic there is at least one big autumn spawning and one big spring spawning community, also separate communities of spring spawners live in different parts of the archipelago.

On the Baltic east coast little is known about the occurrence of different communities.

Recommendations.

1. It is recommended that any group of herring spawning in a given area at a given season from year to year should be defined as the natural "BIOLOGICAL

GROUP". Morphological characters should be used as a practical aid to the identification of these biological groups outside the area and season of their spawning.

2. It is recommended that work on biological groups and other local and seasonal populations should be continued in order to establish and test the continuity of the morphological characters of the biological groups, so that the members of the group and possibly the products of their spawning may be traced as they occur in the fisheries in later life. This will afford research workers data as to effect of fishing on particular shoals and material on which to base predictions.

3. As the biological groups of herrings are in many cases distinguishable by morphological characters, it is recommended that vertebral counts of selected material should be continued, additional characters such as the number of keel scales being also studied when necessary.

4. It is recommended that a co-operative study be undertaken on the practicability of utilizing a count of separate portions of the vertebral series in such a way as to draw distinctions between morphologically distinguishable groups with a minimum of labour and material. Mr. FORD accepted an invitation to prepare a scheme. Professor R. A. FISHER consented to act in an advisory capacity.

5. It is recommended that spawning times be defined by stating the actual months instead of by ill-defined terms such as winter, spring, summer and autumn.

6. It is recommended that the following steps towards co-operative work be undertaken in the northern area.

a) That the group characters of the autumn and the spring spawning populations on the NW. coast of Ireland be investigated and compared.

b) That all countries working in some way or other in the waters of the Faroes, Iceland and Greenland with research ships or other ships available for investigations arrange for material of herring to be collected for (a) age-determination and (b) population-investigations and also for (c) investigations of the distribution of postlarval stages with a view to the study of the herring populations in these remote waters, where continuous work is difficult to carry through, and where recent years' investigations point to an important change in both physical factors and reciprocal in the strength of the spring and summer spawning populations there. Material of spawning herring from different seasons and from all important spawning localities at Iceland are of special interest.

c) That fishing experiments be carried out in the open sea between Norway, Faroe Isles and E. Iceland to collect material in this little explored area in order to get some information as to the possibilities of exchange of population between different parts of this region, and it is strongly recommended that departments having research vessels working in this area make provision for this whenever possible in the programme of work.

d) That the collecting work concerning:

(a) age-composition,
(b) population-characters,
(c) exact determination of maturity and
(d) distribution of post-larvae

is carried out in all important areas systematically and continuously for a period of years.

e) That samples of spawning herring from the Viking Bank are collected and investigated as opportunity occurs.

f) That samples from W. Greenland and from Labrador and Newfoundland are collected with a view to compare the population characters, age-composition, spawning time and growth in these waters.

g) That the Council consider the following question: Important herring investigations have been recently carried out in Russian Northern Waters by U. S. S. R. and it is of importance for the international work to be in contact with these investigations.

7. It is recommended that further investigations be made on the following problems in the North Sea and Channel area.

a) The three sub-groups of "autumn" spawning herring of the North Sea.

b) The degree of mixing, if any, in the winter spawned herrings of the Southern North Sea and Straits of Dover, which, it is recommended, shall in future be known as the Downs herring.

c) The herring of the Smalls.

d) The mixing on the Fladen Grounds.

e) The herring populations in general in the Irish Sea.

8. It is recommended that further investigations be carried out in the Skagerak and Kattegat and Baltic, as follows:

a) As regards the "autumn" spawning populations of the Kattegat, stage VI herring should be analysed from all spawning places from the middle of September to the end of October, for group characters and age-composition. Co-operation is necessary between Denmark and Sweden.

b) Population investigations should be carried out on the eastern coast of the Baltic, on a co-operative basis between the countries concerned.

Annexe A.

The following took part in the discussion, or supplied memoranda for circulation.

Dr. K. A. Andersson.
Dr. A. Bückmann.
Dr. R. S. Clark.
Mr. F. M. Davis.
Dr. W. Erdmann.
Mr. G. P. Farran.
Professor R. A. Fisher.
Mr. E. Ford.
Mr. A. Friðriksson.
Monsieur J. Furnestin.
Monsieur C. Gilis.
Professor G. Gilson.
Professor J. le Gall.
Dr. W. C. Hodgson.
Dr. E. Poulsen.
Dr. S. Runnström.
Dr. E. S. Russell.
Professor W. Schnakenbeck.
Dr. Å. V. Tåning.
Dr. J. J. Tesch.
Mr. H. J. Buchanan-Wollaston.
Dr. H. Wood.

The Administrative Secretary, Captain W. Nellemose, attended the meeting.

Annexe B.

Papers circulated in connection with the meeting.

K. A. Andersson: The Herring groups in the Skagerak, the Kattegat and the Baltic.
F. M. Davis: A Contribution to the "Race Question".
J. Furnestin: Quelques Observations sur les Harengs du Fladen Ground.
J. le Gall: The present State of Knowledge concerning the Origin and Distribution of Herring Populations in Western European Waters.
W. C. Hodgson: The Present State of Knowledge concerning the Origin and Distribution of Herring Populations in Western European Waters. The Southern Bight.
E. M. Poulsen: The Herring Stocks of the Transition Area.
— Yearly Variations in the Number of Larvae of Autumn Spawning Herrings in the Southern Part of the Transition Area.
S. Runnström: The Distribution of the Atlantic-Scandian Spring Herring.
W. Schnakenbeck: The present State of Knowledge concerning the Origin and Distribution of Herring Populations in Western European Waters.
Å. V. Tåning: The Herring Stocks of the Faroes, Iceland and Greenland.
H. Wood: Scottish Herring Race Investigations.

The Herring groups in the Skagerak, the Kattegat and the Baltic.

By

K. A. Andersson.

During the period of heavy herring fishing along the west coast of Sweden this fishery for the main part was based on a herring, which in immense quantities went into the Skagerak and the Kattegat as spent herring during December. This herring may be assumed to belong to the bank herring of the North Sea. As a rule it did not go further south in the Kattegat than to a line from the Tistlarna light house on the Swedish side to Frederikshavn on the Danish side. It left the Kattegat and the Skagerak in March and April.

For the last 15 years this herring has ceased to visit the Skagerak and the Kattegat.

Nowadays the Swedish herring fishing on the west coast is supported by other populations. But the fishery has also decreased on a very large scale.

The fishery is now based upon herring groups which spawn in the Kattegat and the Skagerak. The following are the main groups.

Autumn spawners.

1. The most important group has an average number of vertebrae 56.35. The same average number had already been found by Heincke. This herring spawns in the Kattegat during the period September 15th—October 31st. It goes in to the Skagerak and the Kattegat during the summer. It can be followed by the herring trawlers from July to autumn and it leaves these waters towards the end of the year.

2. A small herring population with a number of vertebrae of 55.98—56.08. It spawns also in the Kattegat in the autumn and seems to migrate to and from the Kattegat.

3. The Sound herring with an average number of vertebrae between 55.49 and 55.56. It spawns in the Sound and also off the south coast of Scania in the Baltic. We do not know, whether it also spawns in the southern Kattegat, but after spawning it migrates into the Kattegat at least up to the island Anholt.

Judging from our experience of the samples analyzed there should be three autumn spawning herring groups in the Kattegat with average numbers of vertebrae, centreing round 56.35, 56 and 55.50.

Spring spawners:

4. In the Skagerak and the Kattegat there is a large herring with an average number of vertebrae near to 57. A. C. Johansen was the first to describe this group of herring and he called it the winter-spawning herring of the Kattegat, but it might also be called a spring-spawning group. It seems to be closely related to the Norwegian spring-spawning herring and is caught in the area east from Laesö island and in the Strömstad archipelago at the northern west coast of Sweden. It spawns during the period February to the first part of April.

As I have pointed out there seem to be at least two different autumn spawning groups in the Kattegat with about the same spawning-places and spawning-time. But the problems concerning these two groups ought to be more closely studied. It is necessary to follow thoroughly the spawning from the middle of September to the end of October and to analyze samples of herring in the spawning-stage from all spawning-places at different times. This will demand much work but I think this area has good possibilities of giving good results from a theoretical point of view concerning the variations of the racial characters and fixing the limits between the different groups.

As is well known the herring fishing is going on along the whole Baltic coast from the southern part up to the northernmost part of the Baltic. We have analyzed samples from the whole Swedish coast. There are both autumn spawners and spring spawners. The most important ones as a rule are the autumn spawners.

Autumn spawners.

The average number of vertebrae varies rather little at this long coast, between 55.45 and 55.64. The average is highest in the middle part of the Baltic off Västervik and Visby with 55.64 and decreases to the south as well as to the north. Off Scania in the south the average is about 55.50 and in the north 55.45. These herring-groups spawn during the autumn along the coast outside the archipelago.

Spring spawners.

There are two different groups of spring herring. One spawns along the coast outside the archipelago. Its average number of vertebrae shows rather small variations, between about 55.43 and 55.55.

The other group lives in the archipelago and shows a low number of vertebrae with variations from one fjord to another. The lowest number found is 55.16 and the highest 55.32.

A Contribution to the „Race Question".

By

F. M. Davis.

Fishermen have a rough and ready practical knowledge of the annually recurrent general distribution of herring shoals. This enables them to exploit appropriate areas at appropriate seasons. It is essential that the fishery scientist should have a more detailed knowledge of the origin and distribution of, and the interrelationships between, the various communities of herring, or other fish. Such knowledge will enable him to watch the effect of fishing in different areas and at different seasons. He may thus become aware of the existence or threat of overfishing. Furthermore, knowledge as to the origin and interrelationships of the various communities from birth to exploitation should give him material for long- or short-term predictions as to the success or otherwise of the different seasonal fisheries. Therefore, as full a knowledge as possible of the life cycles of all groups of herring in the area under investigation is essential.

Now although much is already known as to the origin and distribution of various herring communities, there is one point in which workers are divided into two schools of thought. This is the so-called "Race Question". One school considers that there are "races" which can be distinguished by hereditary characters. The other considers that the distinguishing characters are the result of environmental factors.

Whichever view one holds, one must agree that, from year to year, at certain seasons, different areas support "communities" or "populations" of herring which are recognizable by certain characteristics both physical and physiological. The only point at issue is, are these characteristics hereditary or environmentally induced? In my opinion, the latter is the case. I believe that the physical distinguishing marks of communities are laid down during the plastic period before the hard parts peculiar to the adult are formed, and are subject to the varied modifying influences of the area in which this plastic period is spent.

I should like to stress here that I consider that the detailed question as to whether the distinguishing characters of herring communities are hereditary or environmental is a matter of little or no importance except as an academic recreation. The existence of area and seasonal communities is undeniable.

It seems to me, therefore, desirable to state some hypothesis that will satisfy both points of view.

Known communities of herring exhibit characteristics by which group samples may be referred to their correct community. On the other hand, it is difficult to refer any individual fish to a definite community by means of the standard physical racial characters. Any comparatively "pure" community may be distinguished by

a) A definite area and season for spawning.
b) A group physical character or series of characters.

Thus, *inter alia*, the vertebral counts of the individuals of a sample of a community will conform to a frequency polygon typical of that community from year to year. It is however rarely possible to refer an individual herring to a definite community, simply from its vertebral count, even if this is backed by further physical evidence.

The life of the herring is influenced by an annual environmental cycle and like most other fish, when mature, it spawns once a year. Now, physical characters, such as the number of vertebrae or keel scales, may vary as between individuals of the same community. In the same way, it is equally true that physiological characters such as the date of spawning may vary in the same manner. This is indicated by the fact that all individuals of a community do not spawn simultaneously. The "spawning season" is more or less protracted. Again, individual fish of the same age are not always the same size. There is a modal or most frequent size for herring of any age in any community, and a modal growth rate round which those attributes of the individuals may vary.

It is a fair presumption that other physiological characters including the age and size at onset of first maturity, may vary in a similar manner. A fish may thus reach maturity and spawn for the first time earlier or later than the average of the fellow members of its community-year-class. There is ample evidence that the herring of the community on which the East Anglian home fishery is based do not all reach first maturity in the same year of life. Thus the range of acceleration or retardation of first maturity can be at least a year, and presumably may embrace variations which, being a fraction of one year, will bring the onset of first maturity outside the modal season. It is also an established fact that, outside the spawning season, there is a scattering and intermixture of communities.

Now let us consider the case of a spawning such as that of the Cap d'Antifer area. The products of this spawning will have the physical group characteristics of this area. They are according to the "race" school, the hereditary characters of their parents. According to the other, with which I associate myself, they are the environmentally induced characters of the area.

These products of spawning scatter, feed and grow, grouping and regrouping themselves into shoals — not necessarily confined to their own birth-community — according to size and swimming strength. Eventually, they will arrive within the limits of the time range during which the onset of first maturity may be expected.

Now if it is allowed that the onset of first maturity may exhibit a variation similar to that inherent in other physical or physiological attributes, then the "urge" to spawn will overtake the modal individuals of the community-year-group at a season corresponding to that at which they themselves were spawned. They will thus come under whatever influence — whether it be "instinctive" or "tropic", that induces the spawning migration. Consequently, they will migrate to and spawn in the area in which they were born, and their offspring will be subject to the same environmental influences to which they themselves were subject in early life. Other individuals, will, however, receive the first "urge" to spawn earlier or later than the average individual of the community-year-group, and these will be influenced by the seasonal factors appertaining at the time. They will then join shoals on a different spawning migration from that normally undertaken by their parents.

It will, however, as stated above, rarely, if ever, be possible to distinguish them individually from the original members of the community to which they have attached themselves. Again, they will probably not be present in sufficient numbers for their individual characters to influence appreciably the group characters of this community. The products of their spawning will take on the community physical characters of the new spawning area, and these will coincide with those of the offspring of their new associates. Thus an individual born in January near Cap d'Antifer might come to first maturity two months earlier than the average of its community-year-class and itself spawn in the Sandettie area in November, or it might be nine months late and spawn on the Dogger in September.

I am strongly influenced in my opinion by the work of Hodgson on the l_1 of full herring from the East Anglian home fishing and their spent successors further south. The fact that he finds a polymodal distribution of l_1 coupled with the fact that the position of the modes are constant from year to year seems to me strong evidence that some herring at least that spawn in the Cap d'Antifer area were born in other areas.

To recapitulate — the physical and physiological characters of the individuals of any herring community are subject to the environmental influences of the area in which they were born. They are, all, also, including the onset of first maturity, subject to variation. Thus, the urge to spawn for the first time may overtake a minority of individuals of a community-year-group at a season outside that during which they were born. Consequently, this minority group may join a new community which is preparing to spawn at this time.

This minority group will be too small to influence appreciably the group physical characters of the new community, and therefore its presence will not be detected in samples.

This minority group will produce offspring which will be subject to the environmental influences of the new area.

One can consider the community as a real and constant entity. The term "race" is, however, inapplicable owing to the postulate that racial characters, including time and place of spawning, are hereditary.

There may be an exchange of minority groups between communities, but this will not affect the character of the main communities.

It is suggested that this hypothesis will be applicable to any established communities of herring and will leave workers a full choice as to their interpretation of the factors influencing character.

Quelques Observations sur les Harengs du Fladen Ground.

Par

J. Furnestin.

Le matériel recueilli par le Laboratoire de l'Office Scientifique et Technique des Pêches à Boulogne sur Mer sur les chalutiers boulonnais fréquentant les fonds de chalutage du Hareng de Fladen, de Juillet à Octobre, a été réparti de 1929 à 1934 en deux Groupes, suivant l'état de maturité sexuelle des Harengs. Dans un premier Groupe, nous avons rassemblé tous les Harengs Vierges ou "Guais": (Stades I à III de J. Hjort.) Dans un deuxième Groupe: les Harengs pleins, bouvards ou ayant récemment pondus: (Stades V-VI-VII de Hjort).

Dans chacun de ces Groupes, la moyenne vertébrale a été établie et la répartition du nombre de vertèbres déterminée.

Les résultats obtenus ont été les suivants:

I. Groupe de Harengs Vierges ou Guais.

(Correspondant à des Harengs dont la ponte a lieu au printemps ou au début de l'été).

	Nombre de vertèbres		Moyenne vertébrale 55	56	57	58	Moyenne	σ ±	Fl. M. ±
N = 59	1929. Représentation	%	1.7	34	47.4	16.9	56.80	0.7	0.30
N = 218	1930. Représentation	%	2.3	25.7	61	11	56.80	0.4	0.10
N = 220	1931. Représentation	%	3.2	30	56.8	11	56.755	0.4	0.10
N = 190	1932. Représentation	%	1.6	29.5	53.7	15.2	56.82	0.5	0.11
	1933. Pas d'observations								
N = 125	1934. Représentation	%	4.8	40	48	7.2	56.57	0.7	0.21

II. Groupe de Harengs Pleins et Bouvards.

(Correspondant à des Harengs dont la ponte a lieu en automne).

	Nombre de Vertèbres		Moyenne vertébrale 55	56	57	58	Moyenne	σ ±	Fl. M. ±
N = 49	1929. Représentation	%	6.1	30.6	55.1	8.2	56.60	0.7	0.34
N = 117	1930. Représentation	%	8.6	40.1	46.1	5.2	56.48	0.5	0.16
N = 180	1931. Représentation	%	2.2	40.6	52.2	5	56.60	0.4	0.10
N = 271	1932. Représentation	%	3.7	46.2	47.6	2.6	56.51	0.4	0.08
	1933. Pas d'observations								
N = 72	1934. Représentation	%	4.2	40.2	51.4	4.2	56.55	0.6	0.25

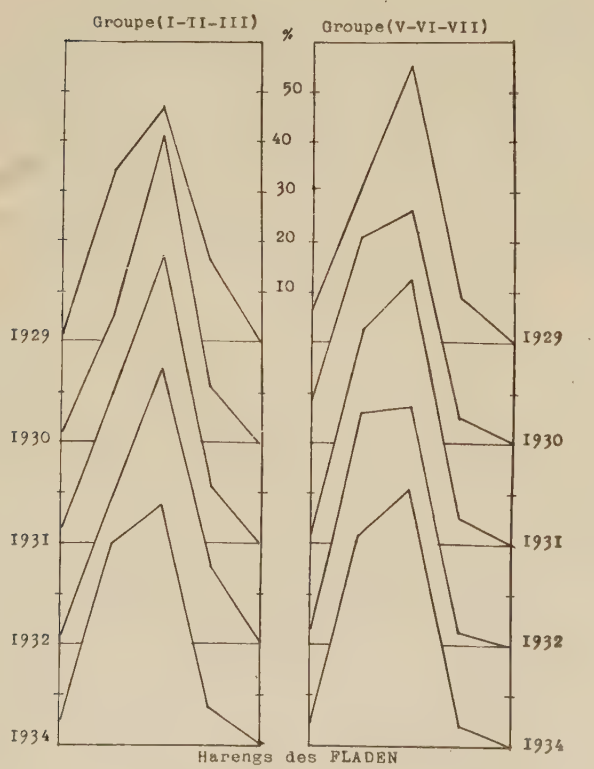


Fig. 1.

Les graphiques ci-joints indiquent, pour chaque année et pour chacun des deux groupes envisagés, les polygones de variation du nombre de vertèbres et les triangles représentatifs des fluctuations de la moyenne vertébrale.

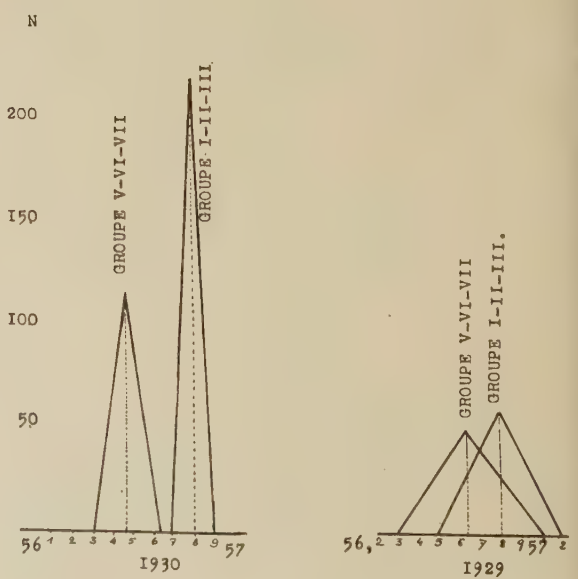


Fig. 2.

D'après ces résultats, on peut conclure à la présence, de Juillet à Octobre, sur les fonds de chalutage du Hareng dits du "Fladen", d'au moins deux populations différentes:

1. Une population de Harengs Atlantiques à moyenne vertébrale voisine de 57.0 et dont la ponte a lieu au printemps.
2. Une population de Harengs d'automne, c'est-à-dire dont la ponte a lieu à l'automne et qui par sa moyenne vertébrale se rapprocherait ou se confondrait avec la population de la Mer du Nord: Type Bank Herring de Johansen.
3. Les résultats de 1934 montrent la possibilité de la présence d'une troisième population, à faible moyenne vertébrale (voisine de 56.50) et dont la ponte aurait lieu au printemps.

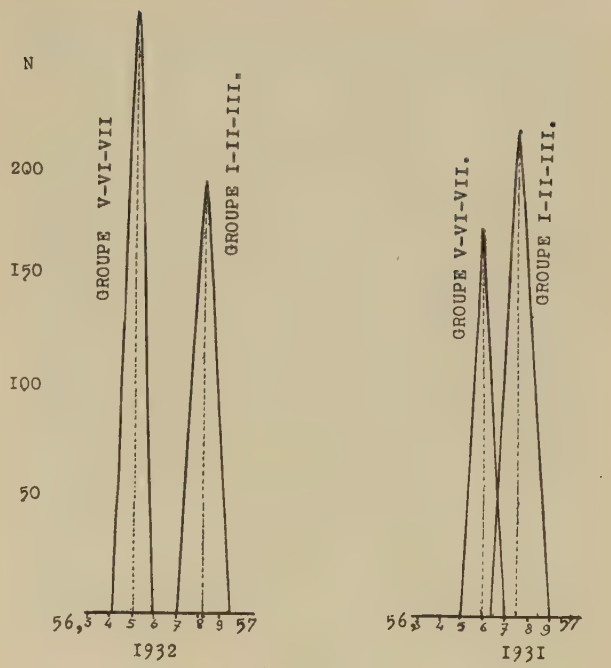


Fig. 3.

The present State of Knowledge concerning the Origin and Distribution of Herring Populations in Western European Waters.

By

Jean le Gall.

Dans un récent travail publié par les Annales de l'Institut Océanographique Tome XV, Fasc. I, le Hareng. *Clupea harengus* Linné. I. Les Populations de l'Atlantique Nord Est — Paris, Février 1935 — nous avons défini aussi brièvement que possible les principales Populations de Harengs vivant dans le Nord Est de l'Océan Atlantique.

En remarquant tout d'abord que toutes ces Populations se ressemblaient par un certain nombre de traits communs, présents avec la même netteté montrant qu'il y a entre les individus qui les composent une parenté plus ou moins étroite et qui ont permis de les classer incontestablement dans l'espèce systématique *Clupea harengus* Linné, nous avons montré qu'un examen attentif de certains caractères plus sensibles à l'ensemble des conditions physiques, chimiques, biologiques constituant le Milieu, permettait de constater des divergences plus ou moins importantes suivant l'origine des Harengs examinés, mais régulièrement de même ordre et de même grandeur quant au caractère envisagé chez des poissons de même origine.

Cette variation fluctuante d'un petit nombre de caractères d'inégale valeur nous a permis de grouper l'immense population de Harengs de l'Atlantique Nord-Est, considérée dans son ensemble, en un certain nombre de Populations Géographiques évoluant dans un domaine bien déterminé. Nous en avons défini les principaux caractères en nous basant, chaque fois qu'il a été possible, sur des observations faites sur des individus capturés sur ou dans le voisinage de leurs frayères.

Les individus constituant ces différentes Populations vivent dans des conditions de milieu similaires, présentent des caractéristiques identiques ou si peu différentes que les différences observées entre les individus d'une même population, ou d'une année à l'autre dans une même population, sont, dans l'ensemble, bien plus petites que celles trouvées entre deux populations distinctes; de plus, les individus de chacune de ces populations se reproduisent directement entre eux. Ils ont donc des relations de parenté.

En nous tenant à la définition donnée pour la Race

par Heincke (1898) il semblerait possible d'attribuer la valeur de Races aux Populations que nous avons définies. Malheureusement la biologie du Hareng reste encore obscure sur bien des points. Nous le retrouvons bien chaque année sur ses frayères, et là, dans l'état actuel de nos connaissances, il est possible de certifier que ce sont les Harengs d'une même population se retrouvant chaque année sur les mêmes frayères; mais, après la ponte, les bancs de Harengs se dispersent. Où vont ils? D'une façon générale on l'ignore encore. Quelques concentrations de nutrition ou de prématuration ont été retrouvées; mais l'étude de ces rassemblements sur le fond a montré qu'ils pouvaient être constitués par des Harengs de diverses provenances, appartenant à des populations différentes. Se séparent-ils ensuite pour se rendre sur leurs propres frayères? C'est très possible et nous le croyons fortement; mais, tant que le fait n'aura pas été vérifié et que les déplacements du Hareng resteront encore inexpliqués, d'une année à l'autre, avant que chaque population se retrouve sur ses frayères, nous éliminerons la notion de Race qui implique une idée de parenté nettement établie pour ne conserver que celle de Population avec le caractère géographique que nous lui avons attribué.

Pour la distinction des populations de l'Atlantique Nord Est, nous n'avons pas attaché la même valeur aux différents caractères fluctuants examinés soit par nous, dans nos observations personnelles, soit par les différents Auteurs ayant étudié des Harengs de provenance diverse et dont nous avons, dans cette étude, relevé les principales observations.

Nous avons systématiquement écarté les caractères métriques suspects d'erreurs systématiques ou accidentales, et, pour les raisons déjà exposées nous ne nous sommes pas arrêtés outre mesure à certains caractères numériques tels le nombre de vertèbres cervicales, de vertèbres caudales, des rayons aux différentes nageoires, d'écailles en carène, dont l'interprétation souvent délicate et le dénombrement parfois difficile rendaient suspecte la valeur du caractère envisagé.

Mais, nous avons attaché une valeur toute particulière au nombre total des Vertèbres des Harengs des différentes concentrations examinées, soit que ce caractère ait été défini sous forme de Moyenne Vertébrale fluctuant dans des limites qui ont été précisées, soit encore que la répartition du nombre de vertèbres trouvé chez les individus des différentes concentrations ait été établie et graphiquement représentée sous la forme de polygones de variation définissant le caractère envisagé et facilement comparables.

Ce caractère est facile à déterminer; il ne peut être suspect d'erreurs systématiques; les erreurs accidentelles peuvent être évitées si le dénombrement des vertèbres est fait avec soin; de plus, il y a tout lieu de croire que le nombre de vertèbres d'un Hareng fixé à un stade très précoce ne sera plus modifié ultérieurement si le poisson suit un développement normal dans les conditions normales qui ont été celles de sa lignée.

Les récentes recherches de J. L. Hart (1933) montrant que la proportion de vertèbres anormales chez les jeunes harengs étant beaucoup plus forte (5.9 %) que celle trouvée chez les adultes (2.3 à 3 %) indiquent que, dans chaque population, la sélection naturelle agit et qu'une mortalité plus forte frappe les individus présentant des anomalies de la colonne vertébrale ou une variation anormale du nombre de vertèbres comparativement au type moyen de la population. Elles apportent une preuve évidente de la valeur du caractère en établissant, ainsi, que dans chaque population ce caractère ne peut varier sous l'influence des conditions de milieu que dans des limites déterminées et confirment les observations faites jusqu'à présent et montrant que, d'une année à l'autre, les variations de la moyenne vertébrale ou la répartition du nombre des vertèbres d'une population restaient régulièrement de même ordre et sensiblement de même grandeur.

C'est en nous basant sur cette moyenne vertébrale et sur la fluctuation du caractère parmi les Harengs des différentes concentrations étudiées que nous avons groupé les différentes concentrations de l'Atlantique Nord Est en Populations distinctes dont nous avons pu préciser utilement la définition par l'examen accessoire de leurs autres caractères numériques ou physiologiques.

Nous avons ainsi distingué dans la population générale de l'Atlantique Nord Est:

I. Les Harengs Atlanto-Scandinaves
groupant les populations régionales de l'Islande, des Féroës, des accores du Plateau Continental de la Mer du Nord, et de la Norvège, dont les caractéristiques sont les suivantes:
Moyenne vertébrale de 57.0 à 57.50, supérieure à 57.00.
Vertèbres cervicales: de 24.3 à 24.6.
Ecailles en carène: de 13.30 à 14.10.

Ces Harengs ont une grande taille à l'état adulte, leur croissance est rapide et continue. Leur ponte a lieu au printemps dans des eaux de température variant de 4° à 8° et de 34.5 à 35.3 ‰ de salinité.

II. Les Harengs Hiberno-Calédoniens
groupant les populations régionales du Nord Ouest de l'Ecosse, du Nord et de l'Ouest de l'Irlande et de la bordure du Plateau Continental Celtique, et caractérisées par:
Moyenne vertébrale voisine de 57.0 (56.9 à 57.0).
Vertèbres cervicales: de 23.9 à 24.7.
Ecailles en carène: de 13.8 à 14.3.

Ce sont encore des Harengs de grande taille, à croissance rapide et continue, dont la ponte a lieu à la fin de l'hiver ou au printemps dans des eaux dont la

température varie de 7° à 9° et la salinité de 34.6 à 35.3 ‰.

Nous leur avons provisoirement rapproché les Harengs d'été d'Islande et des Féroës dont les caractères assez imprécis sont très voisins mais dont la ponte plus tardive n'a lieu qu'en été.

Des considérations d'ordre géographique nous ont amené à réunir ces différentes populations vivant non loin de la bordure du Plateau Continental actuel et constituant nos Groupes Atlanto-Scandinaves et Hiberno-Calédoniens sous la même dénomination de Harengs Atlantiques que nous caractériserons par: leur moyenne vertébrale voisine ou supérieure à 57.00, leur grande taille, leur croissance rapide et continue, et leur époque de ponte ayant lieu au printemps sur des frayères situées à proximité des eaux du large ou atlantiques.

III. Les Harengs de la Manche
trouvés dans toute la Manche et dans la partie méridionale de la Mer du Nord, caractérisés par:
Moyenne vertébrale inférieure à 57.0 et supérieure à 56.50 (de 56.6 à 56.8).
Vertèbres cervicales: de 23.7 à 24.0.
Ecailles en carène: de 14.30 à 15.00.

Ces Harengs, plus petits (à âge égal) que les Harengs Atlantiques, ont une taille moyenne à l'état adulte (25 cm.); leur croissance, plus lente que celle de ces Harengs, se ralentit après la première maturité sexuelle. Ils pondent en automne et en hiver en Manche, dans des eaux dont la température varie de 7.5° à 12.5° et la salinité de 33.5 à 35 ‰.

IV. Les Harengs des Smalls
qui peuplent l'entrée Sud de la Mer d'Irlande, ont quelques caractères voisins de ceux des Harengs de la Manche:
leur moyenne vertébrale inférieure à 57.0 et supérieure à 56.50 varie de 56.6 à 56.9; ils ont en moyenne: 24.5 vertèbres cervicales;
14.1 écailles en carène.

Leur taille est légèrement plus grande (à âge égal) que celle des Harengs de la Manche et leur croissance les rapproche davantage des Harengs Atlantiques que de ceux de la Manche. Leur époque de ponte et l'emplacement de leurs frayères restent encore imprécis.

V. Les Harengs de la Mer du Nord
trouvés en Mer du Nord et parfois en Manche Orientale, caractérisés par:
Une moyenne vertébrale voisine de 56.50: 56.30 à 56.5.
23.85 à 23.90 vertèbres cervicales.
14.75 à 15.25 écailles en carène.

Leur taille est moyenne (23—25 cm.), leur croissance plus lente que celle des Harengs de la Manche se ralentit également après leur première maturité sexuelle. Ils pondent en automne et au début de l'hiver dans des eaux dont la température varie de 9° à 13° et la salinité de 34 à 35 ‰.

Ces trois populations, particulièrement celle de la Mer du Nord et celle de la Manche, présentent entre elles un certain nombre de caractères communs:

Une moyenne vertébrale inférieure à 57.00 comprise entre 56.30 et 56.90, en général moins de 24 vertèbres cervicales, un nombre d'écailles en carène supérieur, en moyenne, à 14.3. Leur taille est moyenne, leur croissance réduite et ralentie après leur première maturité sexuelle. Ils pondent en automne ou en hiver dans des eaux de température et de salinité voisines (T = de 9° à 13°; S = de 33.5 à 35.0 ‰). Ces caractères les distinguent, en outre, des Harengs Atlantiques précédemment définis.

Nous les réunirons sous la dénomination de Harengs Côtiers en considérant qu'elles passent leur existence dans des mers secondaires plus ou moins loin de la bordure du Plateau Continental et dont les eaux côtières (ou continentales) ont un régime hydrologique tout différent des eaux Atlantiques du large ou de la bordure du Plateau Continental.

VI. Les Harengs des Détroits Danois
constituant un mélange complexe de populations distinctes vivant dans une région de transition entre la Mer Norvégienne dont une dépendance: le Chenal Norvégien se prolonge jusqu'à l'entrée du Kattegat, la Mer du Nord et une mer dessalée: la Baltique.

a) Quelques caractères des Harengs Atlantiques se retrouvent chez les Harengs d'Hiver du Kattegat dont la moyenne vertébrale se rapproche de 57.0 (56.75 à 56.90) le nombre de vertèbres cervicales est supérieur à 24.0 (24.0—24.2) et dont la ponte a lieu à la fin de l'hiver dans des eaux relativement froides: 4°—5° et peu salées: 29 à 34 ‰. Leur nombre d'écailles en carène varie de 14.1 à 14.8 et leur taille est généralement petite, bien inférieure à celle des Harengs Atlantiques à âge égal.

b) Les Harengs du Nord Est du Kattegat qui pondent à l'automne dans des eaux chaudes de 11° à 13° et d'une salinité variant de 29 à 34 ‰ présentent également quelques caractères voisins des Harengs Côtiers de la Mer du Nord: leur moyenne vertébrale légèrement inférieure de 56.50, varie de 56.10 à 56.40, leur nombre d'écailles en carène: de 14.4 à 14.65.

Ils ont en moyenne: 24.2 à 24.6 vertèbres cervicales et leur taille moyenne est de 25 cm.

c) Les Harengs du Sud du Kattegat et du Sund s'écartent davantage de ces deux Types: leur moyenne vertébrale est faible, 55.5, et se rapproche de celle des Harengs de la Baltique. Ils ont en moyenne: de 23.8 à 24.2 vertèbres cervicales; 14.2 à 14.5 écailles en carène et ce sont en général de petits harengs dont la ponte

a lieu en automne dans les eaux de 12° à 14°, déjà saumâtre: 8 à 22 ‰.

d) Enfin, les Harengs de Printemps des Détroits (Skagerak, Kattegat et Belts) sont des poissons de petite taille, a moyenne vertébrale voisine de 56.0 (55.9 à 56.25) ayant en moyenne de 23.3 à 23.8 vertèbres cervicales; 14.0 à 14.5 écailles en carène. Ils pondent au printemps dans des eaux de 6° à 12° et de salinité faible: 8 à 24 ‰.

VII. Les Harengs de la Baltique.

Ces harengs passent leur existence entière dans la Mer Baltique: un "grand lac saumâtre" selon l'expression de Suess. D'origine certainement marine, ils se sont adaptés aux conditions de ce milieu particulier et leurs caractéristiques sont nettement différentes de celles des Harengs Atlantiques ou Côtiers.

Ce sont des Harengs de petite taille, dont la croissance déjà relativement lente pendant la première partie de leur existence est très ralentie après leur première maturité sexuelle qui est précoce: à l'âge de 2 ou 3 ans.

Leur moyenne vertébrale est faible, voisine de 55.5 (de 55.2 à 55.6);

ils ont, en moyenne, de 24.5 à 25.6 vertèbres cervicales;

13 à 14 écailles en carène.

Ils pondent soit au printemps, soit en été ou à l'automne dans des eaux de faible salinité (5 à 14 ‰) et dont la température varie de 6° à 10° sur les frayères des harengs de Printemps ou d'Eté et de 11° à 14° sur celles des Harengs d'Automne.

VIII. Les Harengs du Zuiderzee

vivent également dans un grand lac devenu saumâtre depuis la période historique. Leurs caractères se rapprochent des Harengs de la Baltique: petite taille, croissance ralentie, faible moyenne vertébrale (54.80 à 55.30). Ils pondent au printemps dans des eaux de 7° à 13° et de faible salinité: 9 à 11 ‰.

IX. Nous pourrions rapprocher de ces Harengs, adaptés à la vie dans les eaux saumâtres, les différentes populations locales que nous avons signalées dans les fjords de Norvège ou de Suède, à l'embouchure de certains fleuves comme l'Ems, la Jade, la Rade de Morlaix et qui se caractérisent également par une petite taille, une croissance ralentie, une moyenne vertébrale nettement inférieure à celle des populations voisines vivant en pleine mer et pondant généralement au printemps dans des eaux de température variable (5° à 9°) et fortement dessalées.

En considérant les conditions particulières de milieu dans lesquelles vivent ces Harengs de la Baltique, du Zuiderzee, des fjords et des estuaires, nous les avons groupés sous la même dénomination générale de Harengs des Eaux Saumâtres.

Nous tenons cependant à préciser ici le caractère purement conventionnel de cette distinction que nous venons d'établir entre les Harengs de l'Atlantique Nord Est.

Elle a été faite en se basant principalement sur les variations, suivant l'origine des concentrations examinées, d'un caractère particulier de l'espèce: le nombre de vertèbres. Or, cette variation apparaît comme se faisant régulièrement dans un même sens et d'une manière continue; et, de même qu'on ne pourrait établir de limites précises entre les eaux Atlantiques, les eaux Côtières ou Continentales et entre celles-ci et les eaux Saumâtres, domaines que nous avons respectivement attribués à chacun de ces groupes, il ne peut avoir de démarcation absolument nette entre les Harengs de l'Atlantique à moyenne vertébrale supérieure à 57.00, les Harengs Côtiers, où elle varie de 56.20 à 57.0 et les Harengs des eaux Saumâtres où elle est inférieure à 56.20.

Entre les deux types extrêmes que nous avons étudiés: les Harengs Printaniers de Norvège, à moyenne vertébrale voisine de 57.50 et les Harengs du Zuiderzee où elle tombe à 55.0, il existe, en effet, toute une série de types intermédiaires dont la moyenne vertébrale pourrait s'échelonner entre les types extrêmes de façon à former une série continue. Nous avons décrit quelques uns: ceux qui sont actuellement connus; il serait possible d'en découvrir d'autres venant s'intercaler entre eux: en cherchant à les isoler, à situer l'emplacement de leurs frayères, en précisant dans des limites étroites les variations de leur moyenne vertébrale et en leur attribuant, comme à ceux déjà connus, l'étiquette toute conventionnelle de "Population", de "Type", de "Groupe" ou même de "Race".

The Present State of Knowledge concerning the Origin and Distribution of Herring Populations in Western European waters.

The Southern Bight.

By

W. C. Hodgson.

When we begin an investigation such as is suggested by the above title, it is important to appreciate the fact that it is impossible to produce even the slightest piece of direct evidence as to the place of origin of a shoal of herrings. All evidence must of necessity be circumstantial for the following reasons.

1) It is impossible to mark young fish and trace their life history.

2) However good the biometrical analyses of shoals may be, there must always be a certain degree of doubt as to whether any two samples belong to the same population (i. e. come from the same spawning) or belong to different spawnings, the products of which have similar characters, and this doubt must exist in the case of scale calculations as well as in vertebral counts.

The evidence which I propose to bring forward to support my views on the interrelationship between the East Anglian autumn herring shoals and certain well-known spawning grounds is obtained from the results of many growth calculations of scales and measurements of young fish. I have not considered the number of vertebrae to any great extent, but have confined my attentions to the calculated length l_1 in dealing with adult herrings.

Adult Fish.

If we select from a good sample of East Anglian herrings the commonest age-class and calculate the length l_1 from the scales of these fish, we shall find that the curve representing the distribution of the calculated lengths is multimodal, and the commonest type of curve is one whose main mode is at about 7.5 cm., with two subsidiary modes at about 9—11 cm. and 12—13 cm. Such a curve may represent either a straightforward mixture of fish which had been born at different times, or it may represent a homogeneous collection of fish so far as age is concerned, but which for some reason or other had been subjected to certain influences which had brought about variations in the growth of the individuals. The grouping of these modes is shown in Figure 29 — Fish. Invest., Ser. II., Vol. XI, No. 7, 1929.

Young Fish.

By measuring large and varied samples of "0"-group herrings and plotting the modal lengths on a time scale it has been possible to trace the growth of the young fish throughout the greater part of their first year and the general result of this is that we have established three main groups of modes, which, in winter, represent lengths of 7—8 cm., 9—10 cm. and 12 cm.

The curve representing the fish which are 7—8 cm. long in winter has been assumed to be the growth curve of fish which were born in January—February, since the measurements of young fry (Wallace) in March and April connect well with the data obtained from the measurement of the young herrings from May to December.

During all the years when the Thames whitebait has been measured (with one exception) it has been found that the fish belong to this group which is 7—8 cm. long in winter. The constancy of this mode is good circumstantial evidence that these young herrings come from a spawning at a definite place and time.

In the same way, the regularity of the appearance of modes at 9—10 cm. and 12—13 cm. suggests that these fish come from definite spawnings somewhat earlier than the 7—8 cm. group. We believe that the 9—10 cm. fish are the product of an autumn spawning (September—October) and the larger ones are from a spawning in summer (August).

Wallace has shown that it is possible to define two separate broods of post-larval herrings in the Southern Bight, and these he describes as autumm spawned and winter spawned, but he considers that the post-larval herrings of the Thames, Straits of Dover and the Eastern Channel are pure winter brood (January—February).

Now the largest and most concentrated spawning ground we have located is that which lies off Cap d'Antifer and which gives rise to newly hatched larvae in January, so, considering the drift of water from the Channel to the North Sea (Carruthers) we have more evidence that this East Channel spawning ground gives rise to the masses of young herrings which are 7—8 cm. long at the end of their first winter.

The autumn spawned fish have not been so completely traced as the winter spawned ones, but we know that in September—October, an immense amount of spawning takes place on the Western Edge of the Dogger and at Cromer Knoll and the Dowsing area, and Carruthers and Wallace have shown that the fry from these areas can be carried into the Southern Bight.

If we review the evidence, we find that the groups of l_1 measurements are similar to the groups of

measurements of the whitebait herrings in winter, and the simplest explanation is that these are inter-connected, since they are constant from year to year.

We thus may suggest that, since the 7—8 cm. group is commonest, the greater part of the herrings of the East Anglian shoals come from a winter spawning (January—February) in the English Channel and Straits of Dover, and the less frequent group (9—10 cm.) is derived from an autumn spawning — probably to the north of the area. The larger sized group (12—13 cm.) — summer spawned fish — forms only a very small part of the stock.

We have recently obtained further evidence of the connection between the eastern end of the Channel and the Southern Bight, so far as the herring is concerned, for there is a definite relationship between the brood-strength of three-year-old fish in the autumn fishery and certain hydrographical conditions three years previously.

The Herring Stocks of the Transition Area.

By

Erik M. Poulsen.

In the Transition Area a considerable number of herring races occur, undoubtedly on account of the varying hydrographical conditions within this water area. Although much work has been carried out mainly by A. C. Johansen in order to clear up the races and the biology of the herrings of the Transition Area many questions are still unsolved. In the following I shall try to give in broad outline a survey of the principal races of this area and their spawning places.

Shoals of spawning herrings are found in the Transition Area from late summer (August) and right up to late spring (May). However, the predominating spawning time is the autumn and accordingly the most important herring fisheries take place during this season.

We will first consider the autumn and late summer spawning herrings (Fig. 1). The Bank Herring of the North Sea normally do not spawn nearer the Danish coast than in the Dogger Bank Area. But smaller

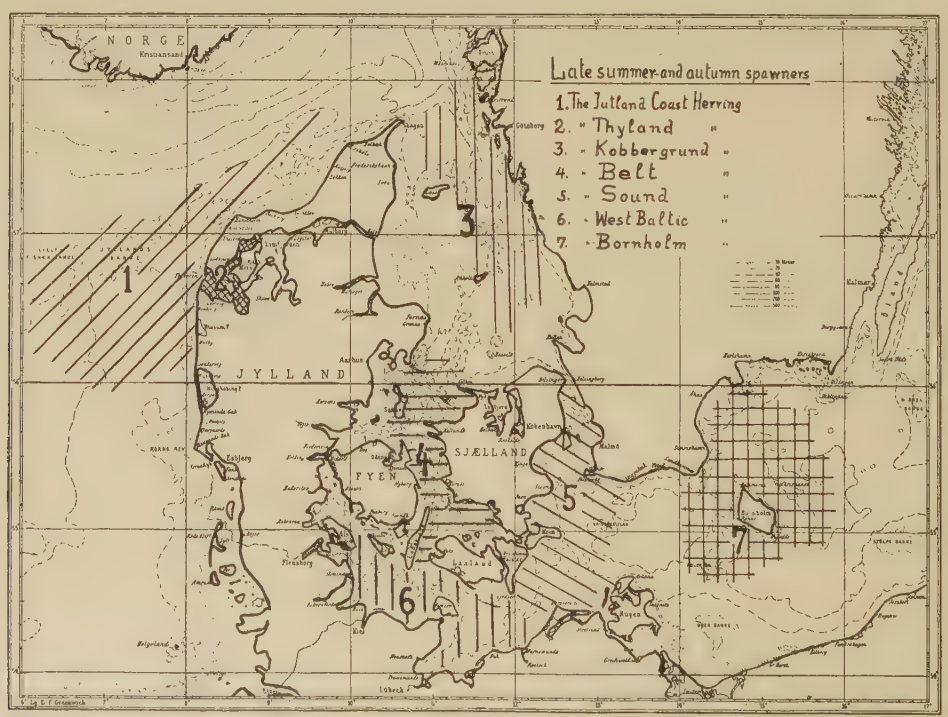


Fig. 1. The spawning places of the principal races of autumn spawning herrings in the Transition Area.

shoals of autumn spawners occur along the Jutland coast especially in the Jutland Bank Area. The numerical features of this Jutland Coast Autumn Herring are as follows: Vert. S. 56.5, K_2 14.6; this is a little lower than those of the Bank Herring. The Jutland Coast Herring must no doubt be regarded as a reduced form of the Bank Herring. Autumn spawning herrings are found also in the westernmost part of the Limfjord. This Thyland Autumn Herring has a still lower number of vertebrae viz. 56.4; no doubt it originates from the North Sea having entered the Limfjord through the Channel of Thyborøn which was formed by strong gales in the years about 1825. This race is thus only about 100 years old.

In the eastern part of the Kattegat large shoals of autumn spawning herrings — the Kobbergrund Autumn Herring — are found, which form the basis of a considerable fishery. The Vert. S. of this race is about 56.3. The situation of the spawning places varies in accordance with the salinity: in years with a high salinity spawning takes place farther south than in years with a lower salinity.

A very important fishery for autumn spawning herrings takes place round the Danish islands and is based upon three nearly related races, viz. the Belt Autumn Herring, the Sound Autumn Herring and the West Baltic Autumn Herring. Of these herrings the Belt Herring has the highest numerical features: Vert. S. 55.8, K_2 14.3, the Sound Herring has 55.6 and 14.2 and the West Baltic Herring 55.5 and 14.2. However the racial questions of these herrings are not yet quite cleared up. It is possible that their numerical features are so close to each other that the 3 races must be united to one race with a lot of local forms in the various coastal areas.

Finally a fishery is carried out in late summer and early autumn around Bornholm on herrings which spawn in August and September; the Vert. S. of this Bornholm Herring is 55.4, K_2 14.1, thus only little lower than in the races spawning in the Belt Sea and the Sound.

The variation in the numerical features of the autumn spawning herrings of the area in question is as follows:

	Approximate Vert. S.	No. of K_2
Bank Autumn Herring of the North Sea	56.5	14.9
Jutland Coast Autumn Herring	56.5	14.6
Thyland — —	56.4	14.6
Kobbergrund — —	56.3	14.5
Belt — —	55.8	14.3
Sound — —	55.6	14.2
West Baltic — —	55.5	14.2
Bornholm — —	55.4	14.1

Thus the Vert. S. and K_2 become lower and lower from the North Sea to the Southern Baltic. However, as regards the number of vertebrae, it seems that the herring races of the said waters can be arranged in 2 groups: one with Vert. S. ranging from 56.3—56.5

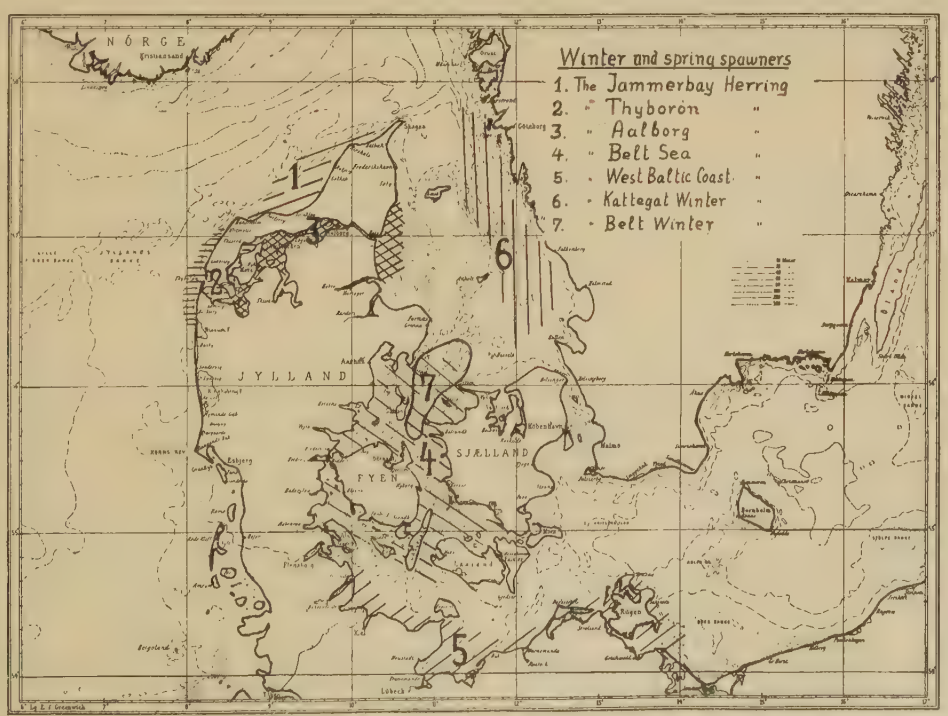


Fig. 2. The spawning places of the principal races of winter and spring spawning herrings in the Transition Area.

comprising the autumn herrings from the Central North Sea, the Skagerak, the Limfjord and the Kattegat, and another with Vert. S. ranging from 55.4—55.8 comprising the autumn herrings from the Belt Sea and the Southern Baltic.

The late winter and spring spawners are as a rule of less importance for the herring fisheries in the Transition Area than the autumn spawners; only in few places they are of rather considerable local importance. (Fig. 2).

In the southern Skagerak a coastal spring herring the Jammerbay Spring Herring occurs with Vert. S. 56.2, K_2 14.1. Another spring herring is found on the Jutland coast of the North Sea and in the westernmost part of the Limfjord, this Thyborøn Spring Herring seems to be nearly related to the Jammerbay Herring, its numerical features being Vert. S. 56.0, K_2 14.4. Whereas these races are only of little importance to the fishery the Aalborg Spring Herring in the Limfjord and the western part of the Kattegat form the basis of a considerable fishery during late spring, its chief spawning time being May. The numerical features of this herring are somewhat lower than those of the previously mentioned spring herrings, viz. Vert. S. 55.7 and K_2 14.2. In various parts of the Belt Sea, in the waters between Sealand and Jutland spring spawning herrings are found; the numerical features of these herrings are only little known, but it seems as if the Vert. S. ranges around 55.7 and the K_2 about 14.3. It is however probable that this Belt Spring Herring consists of a variety of local forms which spawn in different coastal localities. In the German coastal waters of the Western Baltic a spring herring occurs: The West Baltic Spring Herring; this herring has mainly been investigated by Heincke and Altnöder. Its numerical features are rather low (Vert. S. 55.5 and K_2 13.8).

A survey of these 5 groups of herrings gives the following result as regards the numerical features:—

	Vert. S.	K_2
Jammerbay Spring Herring.....	56.2	14.1
Thyborøn — —	56.0	14.4
Aalborg — —	55.7	14.2
Belt — —	55.7	14.3
West Baltic — —	55.5	13.8

Thus both Vert. S. and K_2 are lower than in the autumn herring; the number of Vert. S. is lower in the southern part of the Transition Area than in the northern.

Our knowledge of the numerical features of the spring herrings especially in the Belt Sea is however small and it is possible that further investigations will to some degree give other results.

Finally we must mention 2 winter spawning races (1) the Kattegat Winter Herring spawning in deeper water in the eastern Kattegat during late winter. The Vert. S. is high 56.8 and the K_2 14.6. (2) The Belt Winter Herring spawning in the northern part of the Belt Sea; the numerical features of this herring are not known; only the tiny larvae have been found in late winter in considerable numbers.

Yearly Variations in the Number of Larvae of Autumn Spawning Herrings in the Southern Part of the Transition Area.

By

Erik M. Poulsen.

In the autumn especially in September—October a rather important herring fishery takes place in the Belt Sea, the Sound and the Western Baltic and adjacent parts of the Baltic proper. The base of this fishery is formed by the autumn spawning herring stocks in these waters.

On the initiative of A. C. Johansen cooperative work has been carried out by Denmark, Germany and Sweden since the year 1927 in order to investigate the yearly variations in the intensity of the spawning within the above mentioned areas. As the yearly results of these investigations have been published in the corresponding reports of the Transition Area it is not necessary to go into details as to the method of fishing etc. and therefore I shall at once proceed to state the results of the Danish part of this work.

A question of a certain importance for the value of the investigations dealt with here is to what a degree the numbers of larvae caught by the ring-trawl fishing give a true picture as to the intensity of the spawning. In order to try to elucidate this question I have, for one of the main spawning areas (the waters east of Sealand, Møen and Falster), compared the number of larvae caught during October with the quantity of herrings caught in the whole spawning season (Aug.—Nov.) of the same years, with the following results:

	Catch of Herring metric tons	Mean No. of larvae per 30 min.
1927	184	59
1928	379	379
1929	410	482
1930	253	96
1931	133	172
1932	87	154
1933	81	88
1934	140	106

It will be seen that there is a good agreement between the quantity of herring fished, and the number of larvae caught by the ring-trawl in the same year. Thus there is good reason to conclude that the experimental fishing for the larvae gives a true picture of the actual number of larvae hatched.

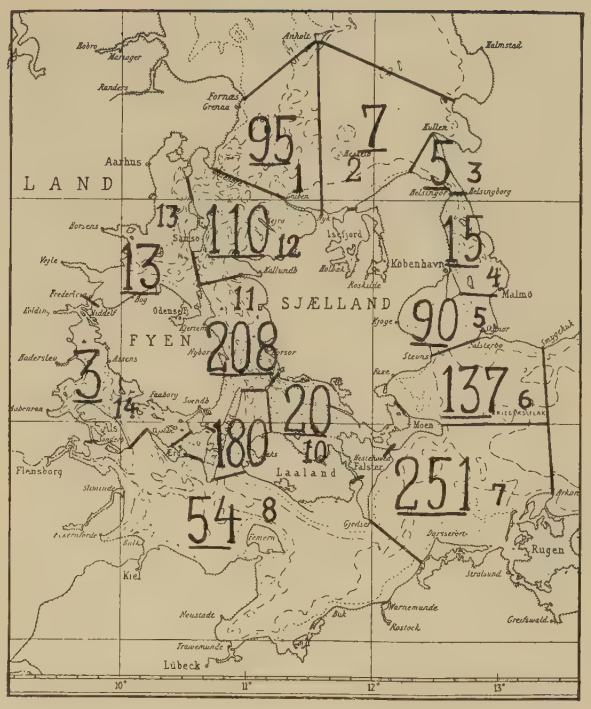
The autumn spawning Sound and Belt Herrings spawn on a rough bottom of gravel or stone in rather shallow water (ca. 5—15 metres) especially on the open coast or on offshore grounds (not so much in inlets (fjords etc.)).

The principal spawning time is the latter half of September and the first half of October, and the larvae are mainly hatched during October. During the years of investigation only few larvae have been caught in the month of September, but as early as the first week of October large quantities of larvae with yolk-sac occur; these small larvae (5—7 mm in length) can be met with through the whole of October. That the larvae are hatched all through October is further shown by the fact that the mean length of the larvae is only little higher in the end than in the beginning of October, as will be seen from the following measurements (No. of larvae in brackets).

	1—3 Oct.	19—27 Oct.
1928 Area 11...	8.07 mm. (317)	8.03 mm. (558)
1929 — 11...	6.24 — (283)	8.07 — (250)
1930 — 12...	7.02 — (63)	6.21 — (210)
1930 — 11...	7.40 — (43)	7.56 — (274)

The investigations have not yet been carried out for a long series of years and thus it is too early to state anything definite as to yearly variations regarding the time of the spawning. However, the material at hand seems to indicate that the spawning is postponed to a certain degree in autumns when the water is comparatively warm.

Fig. 1 shows the number of larvae below 10 mm. caught with a 2 metres ringtrawl per 30 minutes in the years 1927—34 taken as a whole. It appears from the chart that there are two main spawning areas, viz. one for the Sound herring in the southern part of the Sound and in the coastal waters east of Møen and Falster, and another for the Belt herring in the Belts west of Sealand and Lolland. In the north the two spawning areas are clearly separated from each other. In the south the separation is not so clear



No. of Larvae per 30 min. 1927—34. The minor numerals indicate the number of the areas.
Fig. 1.

owing to the fact that we here have the spawning areas of the West Baltic Herring.

The yearly variations for the whole area in the number of larvae caught per 30 min. are as follows:

	No of Larvae < 10 mm.	> 10 mm.
1927	39	5
1928	319	26
1929	123	17
1930	47	5
1931	85	17
1932	57	13
1933	12	3
1934	37	3

It is seen that the number of the smaller and the larger larvae varies in the same manner. The year 1928 yielded the largest amount of larvae; 1929, 1931, and to a less degree 1932 were also rich brood years, whereas 1927, 1930, 1933 and 1934 were poor brood years. Finally it appears that the yearly variations in the number of larvae are very great: the number of the larvae below 10 mm. range between 12 and 319, the number of the larvae above 10 mm. between 3 and 26.

The herring stocks spawning in the area dealt with in this paper are according to investigations carried out supposed to include 3 races, viz. the Belt Herring which spawns in the waters west of

Sealand and Lolland, mainly in the areas 1, 12, 11 and 9 (see Fig. 1), the Sound Herring spawning mainly in the waters east of Sealand, Møen and Falster, in the areas 5, 6 and 7, and finally the West Baltic Herring spawning in area 8. The following survey gives the yearly variations in the spawning intensity of these 3 races (the figures state the number of larvae below 10 mm. caught per 30 min. the 4 highest figures for each spawning area being printed in heavy type, No. of stations in brackets):

Race	Belt Herring	Sound Herring	West Baltic Herring
Area	1, 11, 12, 9	5, 6, 7	8
1927	30 (22)	65 (20)	**42** (8)
1928	**891** (17)	**373** (22)	**115** (9)
1929	**58** (21)	**344** (22)	11 (5)
1930	46 (21)	69 (24)	**95** (18)
1931	**181** (19)	**102** (19)	**54** (3)
1932	**126** (18)	**112** (18)	32 (9)
1933	12 (24)	31 (6)	7 (6)
1934	46 (17)	75 (18)	5 (3)

It will be seen that the Sound Herring and the Belt Herring show corresponding yearly variations in the amount of fry, whereas the variations of the West Baltic Herring only correspond to a certain degree with those of the two other races. However, the number of hauls made in the Western Baltic is rather small and the figures therefore perhaps not reliable. When we look upon the extensive German investigations in the Western Baltic in the same years we get another picture; according to K. Altnöder (1933) the year 1929 was a rich brood year and the year 1930 a poor one just as was the case for the Sound and the Belt Herring. Thus the yearly variations in the amount of fry of these three herring stocks are rather the same, which tends to show that the spawning of the three races of the water in question is governed by the same factors.

The investigations dealt with here have only been carried out for a short period (8 years), and it is therefore still too early to look for correlations between the yearly variations in the number of fry and the hydrographical conditions. However, it seems as if the intensity of the spawning is rather small in autums when the temperature of the water is comparatively high. It is, however, to be hoped that this international cooperative work will be continued for a series of years in order that we may get reliable information as to the factors governing the spawning of the autumn Herring in the Transition Area.

The Distribution of the Atlanto-Scandian Spring Herring.

By

Sven Runnström.

Dr. A. C. Johansen has from his racial analyses in 1919 concluded that the large herrings from Iceland, the Nordland coast of Norway and the south-west coasts of Norway are very closely related to each other, and that they are distinguished by a very high number of vertebrae in comparison with all other herrings hitherto known. He means that it is natural to have a common designation for these groups of herrings and proposes the name "the Atlanto-Scandian Spring Herring". Johansen has in 1921 also found that the Faroese spring herrings belong to the same herring group.

Le Gall has now in his review of the herring populations in western European waters accepted the opinion of Johansen.

I will here try to deal with the distribution of the spawning grounds, migrations and racial characters of this herring group.

On the chart the distribution of the spawning places of the Atlantic spring spawning communities are given according to Scottish, Danish and Norwegian investigations. There is a rather continuous distribution of spring spawning grounds from Northern Norway along the coastal plateau of Norway and along the edge of the North Sea plateau to the Faroes and the south-west coast of Iceland. The localisation of the spawning grounds off the northern coast of Norway which had been based upon the distribution of the newly hatched larvae has now been confirmed by the occurrence of spawning herrings in the same localities during last spring.

Concerning the number of vertebrae in the spawning shoals there is now a rich material from the Norwegian spring herring, but the number of analysed spawning herrings from Iceland and the Faroes is very small. In 1924—25 Johansen obtained for the first time spring herring from the spawning grounds at the south-west coast. An analysis of 84 herrings showed that the Icelandic spring herring had precisely the same number of vertebrae as that found by Broch in Norwegian herrings, namely 57.5. An analysis of about 10,000 spawning herrings from the Norwegian

The distribution of spawning places of the Atlantic spring spawning herring (black dots) and localities where large herrings have been found in summer (rings).

coasts in 1932—35 has shown, as seen from Table 1, that the herrings from the south-west coast have a slightly higher number of vertebrae than the herrings from the more northern spawning grounds, but all the mean values are considerably lower than that given by Broch in 1905. Owing to the lack of fishing on the Icelandic spawning shoals in spring it has proved very difficult to get samples from these shoals, and I have obtained only 66 maturing and ripe herrings from Fakse Bay in February 1933. These herrings have a lower number of vertebrae than that found by Johansen in 1925, but the mean number is very similar to those of the Norwegian herrings in 1932—35. I can therefore confirm the opinion of Johansen that there is no difference between the racial characters of both groups of herrings. Concerning

Table 1. Mean number of Vertebrae.

	Spring Herring		Large Herring	
Norway	1932—34 (Runnstrøm)	1904—05 (Broch)	1932—35 (Runnstrøm)	1904—05 (Broch)
Nordland	n 754 M 57.25	—	—	n 173 M 57.36
Møre	n 3006 M 57.27	—	n 2029 M 57.19	—
Stadt-Bergen	—	n 461 M 57.56	n 3872 M 57.12	—
Bergen-Egersund	n 5110 M 57.36		n 633 M 57.29	—
				—
Iceland	1933 (Runnstrøm)	1924—25 (Johansen)	1931—33 (Runnstrøm)	1924—25 (Johansen)
South coast	n 66 M 57.20	n 84 M 57.49	—	—
North coast	—	—	n 1378 M 57.13	n 204 M 57.48
Jan Mayen	—	—	1930—31 (Runnstrøm) n 378 M 57.21	—
Denmark Strait	—	—	1933 (Runnstrøm) n 49 M 57.16	—

the Faroese herrings also Wood found a much lower number of vertebrae (57.04) in 1934 than Johansen (57.33) in 1921. Lissner mentions too that the autumn spawning herrings from the North Sea seem to have a lower mean number of vertebrae than the at present accepted mean of about 56.5. It seems thus to be a general phenomenon that the mean numbers of vertebrae in later years are lower than those known from observations in previous years, and perhaps this phenomenon can be explained by changes in the hydrographical conditions on the spawning grounds.

Although we have a rather good knowledge of the spawning grounds of the Atlanto-Scandian herring, we know less about the migrations of the herrings after they have disappeared from the spawning grounds. We know that there are great amounts of spring herrings mixed with summer herrings at the north coast of Iceland in the summer, which are supposed to have migrated from the spawning places at the south-west coast. In other parts of the Norwegian Sea no regular fishing on large herring takes place in summer, and the Norwegian large herrings are only caught when they, a short time before spawning, appear at the coast. We possess, however, some information about the distribution of large herrings from fishing experiments with "Michael Sars" and other fishing vessels between Iceland, the Faroes and Norway in 1900—1904 and from Thor Iversen's expeditions to northern waters in 1923—33. On the chart I have plotted the localities where the Norwegian investigators have found large herrings during the summer. We see that the herrings are distributed mainly along the continental slope off Spitzbergen and Bear Island in the North and off Tampen, the Faroe Islands and North Iceland in the South. Earlier in the season spent herrings are found at the Norwegian Nordland coast. But we see that the herrings also can migrate across the great oceanic depths between Norway and Jan Mayen and that they are found on the banks of Jan Mayen, from which locality Iversen brought home some samples in 1930 and 1931.

As the large herrings seem to undertake very extensive migrations in the Norwegian Sea it must be discussed if there is any interchange between the Icelandic and the Norwegian herrings and if the similarity in the racial characters of the Atlanto-Scandian herrings may be contributed to the circumstance that the herrings, to a certain extent, migrate from one area to another.

It is probable to suppose that the large herrings at Bear Island and Spitsbergen spawn on the grounds at the coast of Northern Norway, but the material which mainly consists of single herrings from stomach contents of cod is too small to allow an analysis. The samples from the Viking Bank and Tampen are from the investigation of Bjerkan known to have an age composition very similar to that of the Norwegian spring herrings. About the herrings between Tampen, the Faroes and Iceland we only know that mainly they were of large size.

The only material which is available for a racial analysis are the large herrings from North Iceland, Jan Mayen and the Norwegian west coast. As seen from the table the number of vertebrae of herrings from the three areas is very similar. But an analysis of the age composition (Table 2) gives a rather great difference between the herrings from North Iceland on one side and the herrings from Norway and Jan Mayen on the other. The Icelandic herrings

Table 2. Age distribution.

Year class	1929	1928	1927	1926	1925	1924	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913
Norway Spring 1932	1.8	3.1	0.5	3.7	**19.6**	7.4	**23.9**	**14.2**	4.0	4.3	2.6	12.6	1.0	0.8	0.1	0.1	0.1
Jan Mayen Summer 1931		0.4	—	1.5	**15.1**	12.7	**21.2**	**15.4**	8.1	5.8	6.9	10.0	1.9	0.8			
North Iceland Summer 1932		0.4	0.5	1.2	4,6	5.1	11.9	6.7	8.6	**15.0**	**15.8**	**26.6**	1.8	0.9	0.7	0.3	
Denmark Strait Summer 1933					7.4	—	7.4	11.1	3.7	3.7	**18.5**	**29.6**	7.4	—	11.1		

consist mainly of older specimens with the year-class 1918 dominating. Among the Norwegian herrings the year-class 1918 which formerly was very important is now strongly reduced and the year-classes 1923, 1925 and partly 1922 (specially in the northern areas) are dominating. We find a very similar age composition among the Jan Mayen herrings. The Icelandic herrings are also somewhat larger than the same year-classes of herrings from the two other areas.

Thus it seems that the large herring shoals at North Iceland are not identical with the Jan Mayen herrings and Norwegian herrings, but it is very probable that the Jan Mayen herrings have migrated from the spawning grounds at the Norwegian coast. Owing to our present knowledge I must suppose therefore that there is no mixing of importance of the Norwegian and the Icelandic large herrings. It is more likely to explain the similarity of the racial character in the way that the physical conditions are rather uniform in the places where the herrings from these different areas have their spawning places. However, I will not deny that a migration can take place from Jan Mayen to the east coast of Iceland where the herrings seem to be of less size than those on the North coast, but there is as yet no proof for such a supposition. The area between East Iceland, the Faroes and Norway ought to be more thoroughly investigated through fishing experiments.

It is a peculiar feature with the Icelandic large herrings that they are only observed in July to September when they appear on the north-west and north coast where they form the object of an extensive fishery. In August and September large herrings are also found on the east coast. Where the herrings stay during the other months we do not know. They are of the same racial type as the spring spawning herrings on the south-west coast but there exists no real evidence that we have to do with the same shoals which move round the coast. The number of investigated spawning herrings is very small and we know very little about the age composition and rate of growth. The 66 herrings from Fakse Bay in Febr. 1933 were all young individuals of an age from 3 to 6 years, representing year-classes which were not at all or only very poorly represented among the herrings on the north coast in the same year.

Iversen found, on his expedition to East Greenland in 1933, herrings in various localities in the Denmark Strait in July. One sample contained 50 spent and recovering herrings. In respect to the number of vertebrae and the age composition they are very similar to the large herrings at North Iceland. The herrings are distributed along the deep sea ridge from Greenland to the north-west coast of Iceland. It thus seems that migrations take place between Iceland and Greenland.

It is of course impossible to say where these herrings spawn, but from Paul Hansen's investigations on West Greenland we know that herrings do spawn there. He has found spawning herrings in August at the south-west coast of Greenland of the same racial type as the Icelandic summer spawning herring, but he says that it is also possible that spring herrings spawn there in May and June. I will in this connection mention that the Canadian Fisheries Expedition in 1914—15 found mature and ripe herrings at the Atlantic coast as well in May as in August with a rather similar number of vertebrae (about 56.5). Herrings are also observed on the east coast of Greenland at Angmagssalik, Griffenfeldt Island and Lindenow Fiord and these observations point to a connection between the herrings in the Denmark Strait and those of the south-west coast of Greenland.

Summarizing our experience about the Atlanto-Scandian spring herring one can say that the Icelandic and the Norwegian herrings are closely related forms which cannot be separated by their body characters. But investigations of the age and growth seem to indicate that one can divide them geographically and that they inhabit different areas in the same manner as the Icelandic and Norwegian cod.

From my observations on the Norwegian spring herring I have concluded that the number of vertebrae is not purely inherited but partly influenced by external factors. I find it therefore natural to adopt the view of Lissner that the Atlanto-Scandian herring is closely related to the spring herring at the Shetland Islands and Scotland and that the difference in the mean number of vertebrae very well may be explained by the influence of environment. In fact there is no real difference in the mean number of vertebrae between samples of spring spawning herrings from

the northern North Sea in the year 1934 (57.09 + 0.023, Wood) and samples from North Iceland (57.13 + 0.017) and the Norwegian coast between Bergen and Stadt (57.12 + 0.011). The differences between the mean values are all less than twice the standard deviation. It thus seems unnecessary to combine the Icelandic, Faroese and Norwegian herring into a special group. It seems better to combine all the spring herrings which spawn at the border of the Atlantic Ocean to one large group: the Atlantic spring herring, which can be divided geographically in different groups composed of a greater or smaller number of spawning communities or local forms. It is probable that an interchange can take place between neighbouring spawning communities as known from the northern and western spawning places at the Norwegian coast.

The Icelandic herrings seem to be connected with the Greenland herrings, and in the eastern part there is a connection between the Norwegian herring and the spring spawning herring of Skagerak and Kattegat.

In last spring I found in the outer part of the Oslo Fiord shoals of ripe herrings, mainly of the year-class 1931 with 56.92 vertebrae, thus very similar to the Kattegat winter herring investigated by Johansen. Later in the same month (March) I obtained ripe Norwegian spring herrings from about the same place, mainly of the year-class 1930, with 57.15 vertebrae, and in the inner part of Oslo Fiord spawning shoals (Stage VI) with the two year-classes equally represented and with 57.02 vertebrae. When separating the 4- and 5-year-old herrings in the last sample, the year-class 1930 had 57.0 and year-class 1931 57.19 vertebrae. A mixture had doubtless taken place of the Norwegian and Kattegat herring in the inner part of the fiord where they spawned together. The Kattegat winter herring and the Norwegian spring herring cannot, therefore, represent two different races in the sense of Heincke's definition.

The present State of Knowledge concerning the Origin and Distribution of Herring Populations in Western European Waters.

By

W. Schnakenbeck.

Wenn hier über den gegenwärtigen Stand unserer Kenntnisse von dem Ursprung und der Verbreitung der Heringsschwärme in den westeuropäischen Gewässern berichtet werden soll, so scheint es in Anbetracht der noch herrschenden Meinungsverschiedenheiten über das Vorhandensein oder Nichtvorhandensein von natürlichen, in sich geschlossenen Gemeinschaften angebracht zu sein, sich vor allen Dingen mit der Klärung dieser grundsätzlichen Fragen zu befassen. Und dieses Ziel hat sich die in Hamburg betriebene Heringsforschung zunächst gesetzt. Es soll deshalb hier weniger über Ergebnisse berichtet werden, als vielmehr über grundsätzliche Erwägungen, die uns bei der weiteren Durchführung der Arbeiten leiten sollen.

Nachdem Heincke auf Grund seiner morphologischen Untersuchungen gewisse körperliche Unterschiede zwischen Heringen verschiedener Herkunft festgestellt hatte und dadurch zur Abgrenzung zahlreicher Rassen innerhalb des grossen Verbreitungsgebietes der Heringe gekommen war, haben andere auf diesem Untersuchungswege weiter gearbeitet.

Nun setzt der Begriff "Rasse" aber eins voraus: Die Erblichkeit der Merkmale, die als morphologische Eigenschaften die "Rasse" äusserlich kenntlich machen, und das Vorhandensein einer in sich geschlossenen Laichgemeinschaft, die als biologisch-physiologische Gemeinschaft allein erst eine Rasse zustandekommen lässt und erhalten kann. Dabei ist aber unbedingt festzuhalten, dass das Biologisch-Physiologische, die Laichgemeinschaft, das Primäre ist, das Morphologische erst das Sekundäre. Man darf aber wohl sagen, dass bei den Untersuchungen teilweise das Sekundäre zu sehr in den Vordergrund gerückt, das Primäre zu sehr in den Hintergrund gedrängt oder ganz vernachlässigt ist. Und vielleicht ist dieser Umstand mit eine Ursache dafür, dass gegenwärtig von einigen Seiten das Vorhandensein von "Rassen" bei den Heringen und anderen Fischen überhaupt angezweifelt wird. Die festgestellten verschiedenen morphologischen Eigenschaften werden allein als Ergebnisse der während der Individualentwicklung einwirkenden äusseren Einflüsse angesehen. Bis zu einem gewissen Grade ist das Problem der "Rassen" zu einem Streit um einen Begriff geworden, und es scheint an der Zeit zu sein, die Frage nach den Zusammenhängen innerhalb des Verbreitungsgebietes wieder auf die ursprüngliche Linie zurückzuführen, zumal es sich nicht um eine Untersuchung von rein theoretischer Bedeutung, sondern um Untersuchungen mit durchaus praktischem Ziel handelt.

Man kann die Untersuchungen über die Heringsgemeinschaften in zweierlei Weise durchführen:

1) Untersuchung der "Populationen", d. h. der an einem gegebenen Ort zu einer gegebenen Zeit vorkommenden Schwärme auf ihre Zusammensetzung nach Reife, Alter, Herkunft.
2) Untersuchung der "Rassen", d.h. Ergründung der natürlichen Gemeinschaften.

Da man eine "Rasse" wohl kaum, oder doch selten einmal rein in einem Fang und damit in einer Probe hat, so wird auch eine Untersuchung der "Rasse" zunächst immer auf die Analyse einer "Population" hinauslaufen, nur dass es nicht bei der einfachen Charakterisierung der "Population" bleibt, sondern dass man tiefer eindringt, um die natürlichen biologisch-physiologischen Grundeinheiten zu erfassen. Andererseits muss auch eine nutzbringende "Populations"-Analyse, die nur das Ort- und Zeitgegebene erfassen will, auf die biologisch-physiologischen Zusammenhänge zurückgreifen. Man kann aus diesem Grunde sagen, dass wie die "Rasse" das Primäre und die "Population" das Sekundäre ist, auch den "Rassen"-Untersuchungen die primäre und den "Populations"-Untersuchungen die sekundäre Rolle zukommt. Denn man kann bei "Populations"-Untersuchungen keine Schlüsse auf die in den einzelnen "Populationen" enthaltenen Komponenten ziehen, wenn "Rasse" noch ein umstrittener Begriff ist und das Vorhandensein morphologisch wohl charakterisierter biologisch-physiologischer Einheiten nicht klar erwiesen ist. "Rassen"-Untersuchungen müssen also erst Klarheit über die Grundlagen schaffen. Erst wenn nachgewiesen ist, ob wohlcharakterisierte "Rassen" vorhanden sind, kann man die "Populationen" richtig beurteilen.

Auf welchem Wege kann man nun das Vorhandensein oder Nichtvorhandensein von "Rassen" nachweisen?

Bisher hat man versucht, die Analyse der "Rassen" hauptsächlich nach morphologischen Gesichtspunkten vorzunehmen, indem man möglichst leicht und einwandfrei feststellbare körperliche Merkmale herauszufinden suchte, die dann, wenn gruppenweise Abweichungen vorhanden waren, als "Rassenmerkmale" angesehen und zur Unterscheidung und Abgrenzung von "Rassen" benutzt wurden. Gegen diese einfache morphologische Methode sind dann im Laufe der Zeit manche Einwendungen erhoben worden. Vor allen Dingen mussten diejenigen morphologischen Untersuchungen als nicht einwandfrei angesehen werden, die auf die biologischen und physiologischen Verhältnisse nicht genügend Rücksicht nahmen, d. h. wenn Proben ohne Rücksicht auf ihre Reifezusammensetzung untersucht waren. Es darf auch weiterhin nicht unerwähnt bleiben, dass es vielfach dahin geführt hat, den morphologischen Charakter als das Wesen einer "Rasse" anzusehen. Es darf doch nicht vergessen werden, dass der morphologische Charakter nur ein Mittel ist, uns eine "Rasse" äusserlich erkennbar zu machen, während doch das eigentliche Wesen der "Rasse" die biologisch-physiologische Gemeinschaft ist.

Vor allen Dingen aber ist von einigen Seiten nicht nur der Wert der morphologischen Eigenschaften als Rassenmerkmal, sondern das Vorhandensein von "Rassen" beim Hering überhaupt angezweifelt. Nach dieser Ansicht sind die festgestellten morphologischen Verschiedenheiten nur das Ergebnis formgestaltender Aussenfaktoren, nicht der Ausdruck erblicher Eigenschaften. Um diese Frage geht gegenwärtig wohl zur Hauptsache der Widerstreit der Meinungen, und so muss zunächst, bevor eine Anwendung von "Populations"-Untersuchungen mit praktischem Ziel erfolgreich sein kann, diese Grundfrage nach dem Vorhandensein natürlicher, in sich geschlossener Gemeinschaften geklärt werden. Da sich die Anfechtungen gegen die Rassentheorie hauptsächlich gegen die "Konstanz morphologischer Merkmale" richtet, können diese nicht als Ausgangspunkt der Untersuchungen genommen werden, sondern sie müssen der Endpunkt der Untersuchungen sein.

Bei den Erörterungen über die Frage nach der "Erblichkeit" und nach dem "Einfluss äusserer Faktoren" wird eins offenbar vielfach übersehen, nämlich dass jedes Merkmal ein Produkt von Erbmasse und Umwelt ist. Es wäre danach richtiger, die Frage zu prüfen, ob die Unterschiede zwischen den Rassen erblich oder nicht erblich sind. Durch eine derartige Fragestellung würde wohl die Schärfe der gegensätzlichen Meinungen etwas gemildert. Es besteht ja kein Zweifel, dass beim Hering, und auch bei anderen Fischen, die Umweltsfaktoren formend wirken, es zeigt sich aus den bisherigen Untersuchungen, dass die gestaltenden Umweltsfaktoren nach einer gewissen Regel, wenn nicht gar Gesetzmässigkeit, wirken; dass aber diese Umweltsfaktoren so individuell wirken, dass daraus alle vorhandenen Unterschiede erklärt werden können, muss sehr zweifelhaft erscheinen. Man darf es sich doch auch nicht etwa so vorstellen, dass bei einem Hering eine Wirbelzahl vererbt wird, sondern vererbt wird eine bestimmte Variabilität, und innerhalb dieser Variabilität wird bei jedem Einzelindividuum eine Wirbelzahl realisiert. Ein Rassenmerkmal ist nicht eine Zahl, damit also auch nicht ein zahlenmässiger Mittelwert, sondern Rassenmerkmal ist ein Bild, ein Variabilitätsmodus als Resultante aus Erbmasse und Umwelt. Dabei ist es beim Hering, und wahrscheinlich auch bei allen anderen Fischen, im Gegensatz zu anderen Tieren, nicht möglich, bei Benutzung zahlenmässiger (quantitativer oder numerischer) Merkmale auf morphologischem Wege eine individuelle Rassenunterscheidung durchzuführen, sondern nur eine kollektive.

Man hat nun die Frage nach der "Erblichkeit der Rassenmerkmale" oder richtiger ausgedrückt "Erblichkeit der Unterschiede in den Merkmalen" durch das Experiment zu klären versucht oder glaubt, diese Frage in Zukunft dadurch klären zu können. Was erreicht man durch diese Versuche? Wenn man

einzelne Gruppen von Individuen aus ihrer natürlichen Gemeinschaft herausnimmt und jede dieser Gruppen bei ihrer Fortpflanzung und Entwicklung bestimmten Umweltsfaktoren aussetzt, wobei diese bei den einzelnen Gruppen verschieden gewählt werden, um dann schliesslich die zu prüfenden Merkmale bei den einzelnen Gruppen zu vergleichen, so erhält man daraus nicht ohne weiteres einen zwingenden Beweis dafür, dass innerhalb der natürlichen Gemeinschaften die geprüften Merkmale so inkonstant sind, dass wir sie nicht als Merkmale zur morphologischen Charakterisierung dieser Gemeinschaften benutzen könnten. Solche Versuche geben vielmehr in erster Linie Auskunft darüber, ob gewisse Faktoren auf die Entwicklung bestimmter Merkmale wirken, sowie in welcher Richtung und in welcher Stärke sie wirken. Damit ist nichts gegen den Wert und die Bedeutung solcher Versuche gesagt. Diese müssen vielmehr als äusserst wertvoll bezeichnet werden, da sie uns tieferen Einblick und besseres Verständnis betreffs ursächlicher Zusammenhänge und gestaltender Vorgänge schaffen. Man könnte diese Versuche in eine Parallele stellen mit solchen, die an einem anderen, sicherlich wesentlich labileren Merkmal, nämlich der Pigmentierung, gemacht sind. Diese ist nachgewiesenermassen durch Licht, Temperatur, Ernährung in ihrer Entwicklung zu beeinflussen, und doch sind Unterschiede in der Pigmentierung, selbst gewisse Feinheiten, in hohem Grade erblich und charakteristisch für bestimmte, auch untergeordnete, systematische Kategorien.

Es ist sicherlich der Lösung dieses sehr schwierigen Problems dienlich, wenn es von verschiedenen Seiten angefasst wird. Wenn es Aufgabe der experimentellen Forschung ist, verschiedene grundsätzliche Fragen des Problems zu klären, wird die Untersuchung der natürlichen Gegebenheiten Aufgabe der analytischen Forschung sein. Das Ziel muss sein, die natürlichen Fortpflanzungsgemeinschaften zu erfassen. Um dieses Ziel zu erreichen, ist eine Hauptaufgabe die Erforschung der Laichgebiete und Laichzeiten. Es ist zwar auf diesem Gebiet in den letzten Jahren schon manches geschehen, aber doch sind unsere Kenntnisse noch viel zu lückenhaft. Bei den schon durch die Grösse des Raumes gegebenen Schwierigkeiten müssten diese Untersuchungen unter engster internationaler Zusammenarbeit nach einem einheitlichen Plan durchgeführt werden.

In Anbetracht der mehr oder weniger starken Durchmischungen, die wir fast überall in den Heringsschwärmen finden, hat die Analyse der Schwärme stets grosse Schwierigkeiten bereitet. Man suchte diese Schwierigkeit dadurch zu überwinden, dass man zunächst die Proben nach der Reifezusammensetzung zergliederte. Diese Reifebestimmung wurde nach morphologischen Gesichtspunkten vorgenommen. Nun ist aber der Reifezustand ein physiologischer Zustand. Wenn ein solcher auch in mancher Hinsicht morphologisch zum Ausdruck kommt, so blieben doch bei dieser Methode der Reifebestimmung gewisse Unsicherheiten bestehen. Vor allen Dingen ist aber der Reifezyklus des Herings nicht genügend bekannt, d. h. wir wissen nicht, in welchem Tempo die Reifung erfolgt, wie lange die Gonaden auf den einzelnen Reifestufen stehen bleiben, ob es vielleicht ein gewisses Ruhestadium gibt, auf dem die Gonaden eine Zeit lang verharren. Es gibt im Hinblick auf diese Unsicherheit in unseren Kenntnissen gewisse kritische Stadien in der Reife, die wir vorläufig noch nicht richtig beurteilen können. Wenn man z. B. im Sommer in der NW-Nordsee, wo ohne Zweifel sowohl Individuen von Herbstlaichern wie von Frühjahrslaichern vorkommen, u. a. Reife III findet, so können wir nicht ohne weiteres zweifelsfrei entscheiden, ob darunter Frühjahrslaicher sind, die schon wieder die Reife III erreicht haben, oder Herbstlaicher, die noch auf dem Stadium Reife III stehen. Wie lange dauert die Reifung von der Restitution oder von der jugendlichen Gonade bis zum Stadium III? Wie lange dauert die Reifung vom Stadium III bis zur Vollreife? Und wenn man im Herbst in der SW-Nordsee Heringe mit Reife V findet, so muss man die Frage stellen: Wie lange dauert es, bis ein Hering mit Reife V "fliessend" wird? Trennen ihn nur noch Tage von diesem Zustand oder Wochen?

Das alles sind Fragen, auf die wir vorläufig noch keine befriedigende Antwort erteilen können. Aber die Beantwortung dieser Fragen ist von ausserordentlicher Wichtigkeit. Dringend erforderlich ist also eine Erforschung des Reifezyklus beim Hering.

Damit im Zusammenhang steht die Festlegung einer genaueren Reifebestimmung. Nach der ursprünglichen und auch wohl heute noch am meisten angewandten Bestimmungsmethode nach morphologischen Gesichtspunkten war man dazu übergegangen, die Reife nach dem Verhältnis von Gonadengewicht zu Körpergewicht festzustellen. Diese von Farran und Bowman vorgeschlagene Methode war bisher noch nicht genügend durchgebildet. Die Berechnungen werden nach der Formel $\frac{G \cdot 100}{L\ 3}$ durchgeführt. Als Grenzen für die einzelnen Reifestadien wurden folgende Prozentsätze festgelegt.

R. I	<0.5	R. IV	7—11
R. II	0.5—3	R. V	> 11
R. III	3—7		

Lissner änderte dann nach seinen Untersuchungen die Werte für einige Reifestadien in folgender Weise ab:

R. III	<10	R. IV	10—15	R. V	> 15

Johansen suchte dann noch einen anderen Weg zu einer genaueren Reifebestimmung, indem er Eimessungen vorschlug, indem er davon ausging, dass mit zunehmender Reife die Eier grösser würden.

Wir haben nun beide Methoden genauer geprüft. Die Untersuchungen wurden durch Dr. Erdmann

ausgeführt. Es hat sich aber ergeben, dass sich weder durch die Berechnungen des Verhältnisses Gonadengewicht zu Gesamttier oder auch zu Gesamtgewicht, noch durch Eimessungen eine genaue Bestimmungsmethode ausarbeiten lässt. Statt Eimessungen wurden, weil es einfacher erschien, Eizählungen vorgenommen, und zwar wurde die Eizahl in einem Gonadenstück von jeweils 0.1 g. Gewicht festgestellt.

Zunächst muss betont werden, dass es überhaupt zweckmässig erscheint, die speziellen Reifeuntersuchungen nur an Weibchen zu machen, da bei diesen schon nach dem äusseren Aussehen mit ziemlicher Genauigkeit die einzelnen Stadien unterschieden werden können, während bei den männlichen Gonaden in dieser Beziehung erhebliche Schwierigkeiten bestehen.

Die Verhältnisberechnungen von Gonadengewicht zu Körperlänge ergaben nun so grosse Unterschiede, so grosse Streuungen in den Werten, dass in dieser Bestimmung eine zu grosse Unsicherheit liegt. Immerhin kam Erdmann zu Ergebnissen, die den von Farran und Bowman gewonnenen näher liegen als den von Lissner gewonnenen. Die Werte nach Erdmann sind folgende:

R. I	<0.5	R. IV	8—13
R. II	0.5—3	R. V	> 13
R. III	3—8		

Aber doch ergab sich, dass diese Werte nicht für alle Heringe unbedingte Gültigkeit haben. R. V lässt sich z. B. an dem glasig durchsichtigen Aussehen der Eier eindeutig bestimmen, und doch stellte Erdmann fest, dass bei einigen Heringen mit einem Prozentsatz von 19.2 noch keineswegs von R. V die Rede sein konnte und andererseits bei einem Prozentsatz von 9.2 ohne Zweifel schon R. V vorlag. Vor allen Dingen zeigte es sich aber auch, dass Verschiedenheiten bei Heringen verschiedener Herkunft auftreten (verglichen wurden Heringe aus der Nordsee, Ostsee und von Norwegen). Man kann also keinesfalls allgemeingültige Werte für den Hering schlechthin feststellen, man müsste mindestens gesonderte Werte bestimmen für Heringe verschiedener Herkunft.

Wie es mit den Gewichtsverhältnissen ist, so ist es mit der Eizahl. Auch hier findet man eine grosse Streuung und ein weites Übereinandergreifen der Werte, sodass eine scharfe Trennung nicht möglich ist. Bei Heringen vom Dogger wurden z. B. bei R. IV Eizahlen von 160—298 auf 0.1 g. gezählt, bei R. V von 122—246, das ist also ein weites Übereinandergreifen der Werte. Und ebenso sind Unterschiede bei Heringen verschiedener Herkunft vorhanden. Im Durchschnitt hatten bei R. V die Heringe aus der Ostsee 177, vom Dogger 173 und von Norwegen 45 Eier auf 0.1 g. Besonders auffallend ist die geringe Zahl bei den norwegischen Heringen, die also sehr viel grössere Eier haben als die Heringe aus der Nordsee und Ostsee.

Es zeigt sich also, dass beide Methoden, Gewichtsverhältnisse und Eizahl bezw. Eigrösse, nicht zu einer genaueren Bestimmung der Reife führen, als es durch das Äussere der Ovarien möglich ist. Da aber diese Bestimmung nach dem äusseren Aussehen bei den Männchen schwierig ist, sollte man sich aus Zweckmässigkeitsgründen bei den Untersuchungen über die Zusammensetzung der Schwärme zur Hauptsache auf die Weibchen beschränken. In Bezug auf die Trennung der biologisch-physiologischen Gemeinschaften bleibt aber auch da noch immer die Unsicherheit bestehen, dass wir über die Dauer der einzelnen Reifestadien nichts wissen. Aber immerhin besteht vielleicht noch die Möglichkeit, in Verbindung mit Gewichtsfeststellungen, Volumenbestimmungen, chemischen Untersuchungen und Wachstumsuntersuchungen tiefere Einblicke in die biologisch-physiologischen Verhältnisse zu bekommen. Es muss versucht werden zu prüfen, ob nicht auf diese Weise schon gewisse Typen zu finden sind, die durch ihre physiologischen Eigentümlichkeiten zu erkennen sind. Wenn dann diese physiologischen Eigenschaften mit den morphologischen zusammenfallen würden, so wäre man damit auf zwei Wegen zu dem gleichen Ergebnis gekommen.

Diese Untersuchungen sind sehr langwierig, man kann nicht aus wenigen Beobachtungen voreilige Schlüsse ziehen. Wenn derartige Untersuchungen in Hamburg auch bereits begonnen haben, so sind sie doch noch in den Anfängen. Die Methodik muss erst ausgebaut werden, und es ist deshalb vorerst nicht möglich, über Einzelheiten oder gar Ergebnisse etwas zu sagen. Wenn aber auf diesem oder auf einem anderen Wege erst die natürlichen Gemeinschaften charakterisiert sind, werden die Populationsuntersuchungen eine wesentlich grössere praktische Bedeutung haben.

The Herring Stocks of the Faroes, Iceland and Greenland.

By

Å. Vedel Tåning.

Contributions to the study of the herring in the waters of the Faroes, Iceland and Greenland are scarce. Most important are the papers by A. C. Johansen on the racial characters of the different races in Faroe and Iceland waters; furthermore various contributions are given in papers by Johs. Schmidt, B. Sæmundsson, P. Jespersen, A. Friðriksson, Paul M. Hansen, R. S. Clark, H. Wood, E. Lea and others; some of these contributions have appeared in the administrative reports of the North Western Area Committee.

The herring fishery off North Iceland in the months July—September is an important fishery; a fishery of small importance takes place off south-west Iceland and in various Faroese fjords; no herring fishery takes place at Greenland.

I. The Faroes.

A. Racial Investigations.

A. C. Johansen (1919 and 1921) has shown that a spring spawning and a summer spawning herring occur at the Faroes. Of these the spring spawning herring is the most important; the fishery is, however, of minor importance.

1. Johansen found the following values in samples of the spring spawning race (number of specimens investigated in brackets):

	April 1920	Sept. 1915
Vert.	**57.33** (160)	**57.47** (207)
K_2	**13.74** (158)	**13.85** (207)

Wood (1935) found, however, the following values in three samples from April 1934 [samples 1) and 2) immature herring, sample 3) maturing adult spring spawners], i. e. a lower number of vertebræ than given by Johansen.

Vert.	1) **57.09** (173)	2) **57.17** (86)	3) **57.04** (104)
K_2	**13.83** (166)	**13.73** (86)	**13.92** (102)

2. Furthermore Johansen gives the following values for the summer spawning herring of the Faroes (August 1919).

Vert.	**56.90** (124)
K_2	**13.82** (124)

Further investigations are highly desirable.

B. Spawning and occurrence of postlarvæ.

The spawning localities and postlarval stages of the summer spawning race have not yet been found; samples with ripe or nearly ripe individuals have, however, been taken in different fjords in late August.

The postlarval stages of the spring spawning race have previously been mentioned from two fjords (P. Jespersen 1920 p. 10); in recent time "Explorer" has taken a few postlarval stages off the islands in May and June 1931 and 1933 (Clark 1934), and "Dana" has in 1934 in April—July shown that rather high numbers (up to about 200 spec. per 15 minutes haul with 2 meter stramin net) may be met with especially on the Suderø Bank (supplementary investigations in March—April 1935 confirm this). The actual spawning localities are unknown. The spawning is probably on its highest in February, March and April, however, in some fjords also later but to an insignificant degree.

II. Iceland.

A. Racial Investigations.

A. C. Johansen (1919, 1921 and 1926) has shown that two races of herring occur at Iceland, the spring spawning and the summer spawning herring with the following characteristics:

1. The spring spawning herring or "Atlanto-Scandian spring Herring" of Johansen (number of specimens investigated in brackets):

Samples from South-Iceland:

	Selvogs Banki S.-Iceland March-April 1924—25.	Fuglasker SW.-Iceland 14. Sept. 1924	Hornafjord SE.-Iceland 28. July 1900
Vert.	**57.49** (84)	**57.55** (11)	**57.56** (16)
K_2	**13.70** (81)	**13.67** (12)	..

Samples from North-Iceland:

	Off Eyjafjord N.-Iceland 12. Sept. 1924	Eyjafjord[1]) N.-Iceland Sept. 1915	Skagafjord N.-Iceland 22. July 1924
Vert.	**57.49** (49)	**57.36** (192)	**57.48** (143)
K_2	**13.79** (48)	**13.84** (192)	**13.90** (136)

[1]) This sample contains about 30 % summer spawning herring (according to Johansen 1926, p. 127).

It will be noted that very few (84) specimens of actually spawning individuals have been investigated.

2. The summer spawning herring:

amples from South-Iceland:

	Eldey SW.-Iceland May 1919	Drangar S.-Iceland 14. Aug. 1919
ert.	**57.07** (297)	**57.01** (180)
K_2	**13.52** (295)	**13.68** (180)

amples from North-Iceland:

	Køgur NW.-Iceland 6. Sept. 1924	Eyjafjord N.-Iceland Sept. 1915	Off Eyjafjord N.-Iceland 12. Sept. 1924
ert.	**57.08** (36)	**57.00** (31)	**56.98** (47)
K_2	**13.57** (37)	**13.84** (31)	**13.68** (47)

Racial investigations have not yet been carried out n summer spawning herring taken off south-east celand, where in recent years the most important pawning has taken place as far as we know.

. Spawning and occurrence of postlarvæ.

Sæmundsson and Jespersen have reported on the pawning areas and occurrence of postlarvæ. During ne investigations carried out by Johs. Schmidt at celand 1903—08 it was proved that the herring like ne cod spawn at the warmer coasts of Iceland (West nd South), and that a spring spawning as well as a ummer spawning herring was found here (Jespersen 920). The great herring fisheries on the north- (and ast-) coast are carried out on spent (and immature) erring only. The investigations in 1903—08 showed ighest numbers of spring spawned herring larvæ. . C. Johansen (1921, p. 23) writes as to the distri- ution of the summer spawning herring: "Up till ow we find nothing which points in the direction hat the summer spawning Icelandic herring has a milar extensive distribution to the Atlanto-Scan- lan spring herring."

Recent years investigations, however, seem to nphasize that the summer spawning herring in the eriod at present (characterised by higher tempera- ures in the Icelandic waters) is the strongest, accord- ng to the distribution of postlarval stages, ith probably two maxima of concentration (off outh-West Iceland and off South-East Iceland).

The highest number taken per haul of spring ostlarvæ calculated per 1 hours haul (young fish awl) was found in 1904 to be about 4.400 speci- ens (off South Iceland). On the other hand we und in late July 1933 the summer postlarvæ resented in much greater numbers, viz. off South- ast Iceland about 24.600 specimens per 1 hours aul (2 metres stramin net). According to Sæmunds- n's and Johansen's chart 1921 p. 22, no spawning summer spawning herring was known off this part of Iceland at that time. In 1927 Johansen (1927 p. 11, footnote) mentions, that Sæmundsson now had informed him that spawning fish had been observed at the South-East coast of Iceland; see also Sæmundsson 1934 p. 4—5.

Friðriksson (1935) has put forward a theory according to which the herring caught off North Iceland in the Summer should possibly be of Norwegian origin; this theory has to be proved but is, however, not supported by the high numbers of postlarval stages found in Icelandic waters (see above). A certain interchange of adult specimens is of course possible.

III. Greenland.

The herring is known only by a few specimens from East-Greenland (Angmagssalik and further south); in West-Greenland the species is rather common now.

The herring of Greenland is probably of Icelandic origin (the summer spawning race); in colder periods the stock is probably dependent on immigration from the Icelandic area. Formerly the species was known from a few localities near Frederikshaab only (62° N. Lat.), now it is known from higher latitudes too (up to 65°37′ Lat. North, probably in few specimens as far north as 72°20′ N. Lat.) and in some localities rather abundantly. Maximal size 44 cm. according to Paul M. Hansen.

A. Racial Investigations.

According to investigations by Paul M. Hansen the herring caught at West-Greenland show racial characters identical with the summer spawning herring of Iceland. A spring spawning herring has not been met with in Greenland waters.

The following particulars have kindly been given by Mr. Paul M. Hansen:

	ca. 65°30′ N.L. Sukkertoppen 1930	62°15′ N.L. Avigait 1932	60°35′ N.L. Sardlok 1932	60°35′ N.L. Sardlok 1930 and 1932
Vert.	**57.10** (101)	**56.89** (172)	**56.94** (150)[1]	**56.92** (100)
K_2	..	..	..	**13.87** (22)

[1]) Spawning herring.

B. Spawning and occurrence of postlarvæ:

Spawning shoals have in August been met with by Paul M. Hansen close to the coast line (depth of waters about $^1/_2$ meter), where the highest temperatures are found. Eggs with embryons have been found in one locality (near Cape Farewell). Postlarval stages have, however, not yet been found at West-Greenland; but small herring of a size of about 5 cm. have been captured in recent years, from which we may conclude that successful spawning has taken place.

Scottish Herring Race Investigations.

By

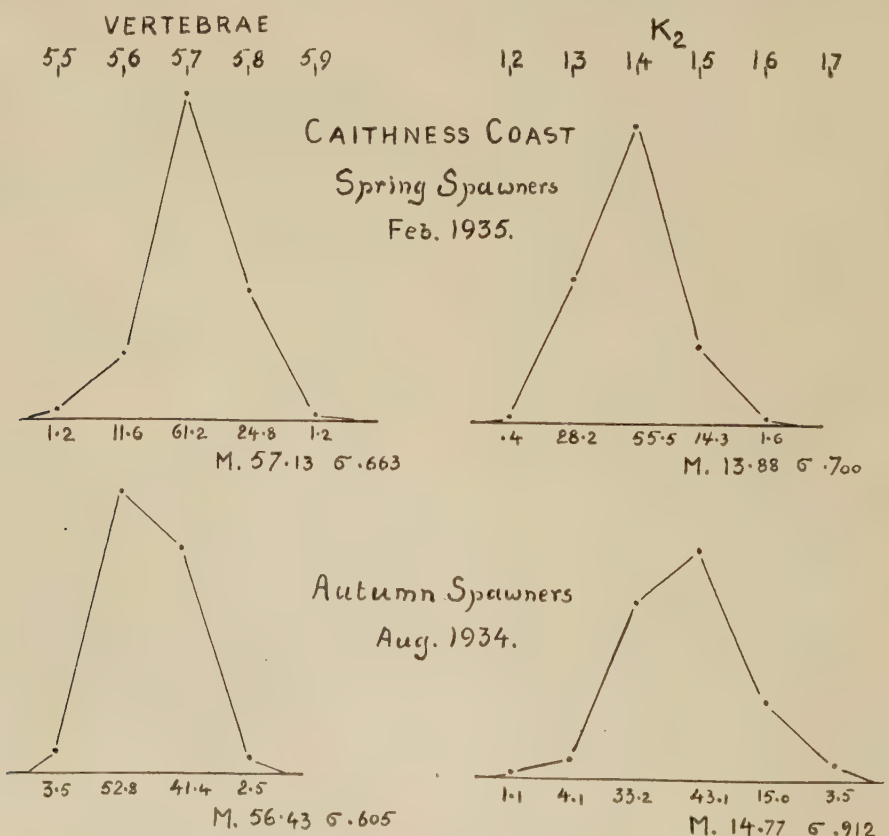
H. Wood.

Précis.

Race investigations of herring were commenced in Scotland in 1921, but they were not carried on systematically until 1931 following the last meeting of experts at Lowestoft in 1930. The first efforts were directed towards establishing morphological points of difference between the autumn spawning and spring spawning components of the herring population. This work has now been satisfactorily completed and has proved that spring spawners and autumn spawners are identifiable from each other by significant differences in the number of vertebrae and keeled scales, spring spawners being characterised by a relatively high number of vertebrae and a low number of keeled scales (K_2) and autumn spawners by a relatively low number of vertebrae and a high number of K_2. Two typical samples from the same fishing grounds are here given by way of illustration.

There would appear to be a definite relationship between the number of vertebrae and K_2, increases in the number of the vertebrae being associated frequently, if not invariably, by decreases in the number of K_2 and vice versa. The K_2, being apparently more plastic and susceptible to environmental conditions, have a wider range of variation than the vertebrae and for that reason have been discarded by most investigators as unreliable for race work. In some areas, however, the number of K_2 remains as constant as the vertebrae, but significant differences appear in different communities having the same spawning season. This character is, therefore, by no means valueless, but when used in combination with the vertebrae offers a means of distinguishing different communities of the same stock or race.

While the frequency distribution of vertebrae and K_2 of both spring and autumn spawners conform



respectively to the types illustrated above, some variation is apparent in both characters, depending in some cases at least on the place of origin of the material. The greatest range of variation has been observed among the spring spawners from the region of the Firth of Forth and investigations carried out in 1934 and 1935 have shown that the extreme variation in this area was due in a large measure to mixing on the spawning grounds of shoals derived from different sources.

"Race" analysis has proved a reliable aid in assessing the composition of the shoals in the North-Western North Sea whether immature or adult and in dispelling misconceptions concerning the identity of the herring caught by trawlers on the Fladen Ground. Through its aid it has been possible to trace during the summer the divergent movements of bodies of autumn and spring spawners, which had been associated together in the same feeding shoals. There has also been revealed off the Scottish N. E. coast during early summer the presence of a group of herring closely allied to the Scottish autumn spawners, but whose spawning times and spawning places have not yet been ascertained.

COPENHAGEN MEETING OF EXPERTS FROM BALTIC COUNTRIES

December 4th and 5th, 1935.

Convener: Dr. K. A. Andersson.

At the Council Meeting in May, 1935, the following Resolution was passed on the recommendation of the Baltic Area Committee (cfr. Rapports et Procès-Verbaux, Vol. XCIV, p. 31):

"It was recommended that a Sub-committee of experts from the participating countries at a separate meeting should deliberate more closely the questions of further measures for protecting the stocks of fishes in the Baltic."

Dr. K. A. Andersson, Sweden, was appointed convener of this meeting and by correspondence the place and date was fixed by mutual consent. The meeting was held at Villa "Eltham", Copenhagen, on December 4th and 5th, 1935, and the following experts were present from the respective countries:

Denmark: Dr. H. Blegvad, Dr. Erik M. Poulsen and Magister C. V. Otterstrøm.
Finland: Professor T. H. Järvi.
Germany: Dr. E. Fischer and Dr. S. Strodtmann.
Latvia: Mr. V. Miezis.
Poland: Professor M. Siedlecki and Dr. F. E. Lubecki.
Sweden: Dr. K. A. Andersson, Dr. A. R. Molander and Dr. G. Alm.

In attendance: the Administrative Secretary, Captain W. Nellemose, and Dr. Aa. J. C. Jensen.

The meeting was opened on December 4th at 11 a.m. by the convener, Dr. K. A. Andersson, who drew attention to the Agenda previously circulated.

Agenda.

1. Opening of the meeting.
2. Election of chairman.
3. Flounder.
   a) Lectures.
   b) Discussion.
   c) Decision as to possible recommendations concerning better international protective measures for the flounder in the Baltic.
4. Salmon.
   a) Lectures.
   b) Discussion.
   c) Decision as to possible recommendations concerning international protective measures for the salmon in the Baltic.

Proceedings.

At the proposal of Professor Siedlecki, Dr. K. A. Andersson was elected chairman.

In order to save time the chairman suggested that a member from each country gave a short lecture on the investigations in his country, in the forenoon on the flounder, and in the afternoon on the salmon. A discussion would then take place the following morning and the meeting was thus expected to conclude on Thursday afternoon with resolutions and recommendations as might be decided upon. It was decided that minutes of the meeting with copies of manuscripts of lectures be kept in the Archives of the

Bureau and that a summary report only with recommendations be printed and included in the annual Administrative Report.

I. Flounder.

In accordance with this the following members spoke on the investigations in their respective countries: Dr. Molander, Sweden, Professor Siedlecki, Poland, Mr. Miezis, Latvia, Dr. Strodtmann and Dr. Fischer, Germany, and Dr. Blegvad, Denmark; Professor Siedlecki read a letter from Oberfischmeister Stahlberg from Danzig who had similar views on the questions as the Polish experts.

Dr. Molander and Dr. Blegvad were in favour of protective measures through increased size-limit, while the German experts were of the opinion that close-time during spawning would be better means of protecting the flounder in connection with minor increase of the minimum sizes. Professor Siedlecki expressed the view that minimum size and close-time for flounder should be introduced on the same lines as formerly for the plaice.

A thorough discussion on the points of view expressed developed between all members present, and it was finally decided to accept Recommendation I.

II. Salmon.

Concerning the salmon question Dr. Alm spoke about the investigations in Sweden, Professor Järvi for Finland, Professor Siedlecki for Poland, Mr. Miezis for Latvia, Dr. Blegvad for Denmark, and Dr. Strodtmann read a letter from Professor Willer about the German investigations.

During the ensuing discussion Dr. Alm recommended a minimum size of 60 cm. and Professor Järvi, Mr. Miezis and Dr. Blegvad a minimum size of 50 cm. The German and Polish experts agreed that a 50 cm. limit could be recommended, but that the coastal salmon fisheries of these countries still needed further investigations.

The question was thoroughly discussed by the members present and the Recommendation II was passed unanimously.

Recommendations.

I. The more intensive fishery in the Baltic due to the development of technical means of the fishery necessitates the introduction of further protective measures in respect of the Baltic flounder fishery.

The flounder fishery is approaching a critical stage, as

1) the old stock is disappearing;
2) an important decrease in the stock of spawning flounders has been substantiated;
3) the average age of the total stock has decreased considerably.

For these reasons the catches of marketable fish consist almost exclusively of a few year-classes (the III to V-groups). The danger, therefore, must not be overlooked that the failure of a single year-class by unfavourable conditions may have disastrous effect on the flounder fishery. So far the statistics do not show any considerable decrease of total catch and the Committee, therefore, has waived measures of vital encroachment. In case the necessary biological and market statistical investigations should prove further development of the above mentioned critical state of the flounder fishery, stronger measures ought to be considered.

For protective purposes an increase of the size-limits, introduced by the 1930-Convention, and protection during spawning is recommended; the goal of the latter may be reached, either by (1) the introduction of a close season or (2) by increased size-limits for flounder to 25 cm. during the spawning season, viz. February 1st to April 30th.

For the protection of the young flounder it is recommended to increase by 1 cm. at least all size limits mentioned in the 1930-Convention. In this connection a minimum mesh of 50 mm. for flat-fish trawling nets is recommended in the area west of the line Utlängan to the German-Polish frontier.

II. The Committee has come to the conclusion that uniform protective measures for the Salmon in the whole Baltic would be of great value.

The introduction of a general size-limit of 50 cm. is recognized as justified for biological reasons.

NORTH-EASTERN AREA

1935.

By

Oscar Sund (Vice-Chairman).

It appears from the replies received from the members of the North-Eastern Area Committee that fishery research work, on behalf of the countries participating in the International Council, has been carried out in the North-Eastern Area by Germany and Norway mainly while the Scotch R/V "Explorer" paid a brief visit to the waters off Bergen during April. The German and Norwegian investigation of the commercial catches of the northern fish stocks complete each other; a sampling of these stocks from the Norwegian catches only, which consist of fish approaching the coasts, might be considered one-sided while the catches of the German trawlers (sampled in Wesermünde) were taken at various localities all over the Barents Sea from Bear Island to Kolguev and Novaya Zemlya and only in part on the Norwegian coast.

Germany (J. Lundbeck).

The investigations into the landings have been continued as before. The market measurements comprise 31,443 individuals, distributed as follows:

Species	Cod	Haddock	Saithe	Total
Barents Sea:				
Number	6,800	7,176	—	15,976
Weight, kg.	27,090	12,260	—	39,350
Number of samples	27	19	—	46
Bear Island:				
Number	7,937	4,352	—	12,298
Weight, kg.	25,328	8,435	—	33,736
Number of samples	19	16	—	35
Norw. Coast:				
Number	2,261	2,717	200	5,178
Weight, kg.	9,680	5,698	780	16,158
Number of samples	10	10	1	21
Total:				
Number	16,998	14,245	200	31,443
Weight, kg.	62,098	26,393	780	89,271
Number of samples	56	45	1	102

Further, weighing of individuals has been commenced and will be continued during 1936; the numbers weighed in 1935 are as follows:

Barents Sea	1,949	1,783	—	3,732
Bear Island	1,352	175	—	1,527
Norw. Coast	486	—	200	686
Total	3,787	1,958	200	5,945

For the first time it has been possible more closely to follow the development of the fishery through the newly introduced collection of information as to place and number of day's fishing; previously, random samples were taken and estimates only were made.

During the fishing period 1934/35 an increase of the cod as well as the haddock returns took place, the former due to change in the stock caused by the increasing weight of the young fishes, the latter owing to a strong immigration of young fishes and a delayed emigration of old ones. An investigator had the opportunity of studying the distribution and age composition of younger haddock on a voyage onboard a Wesermünde steamtrawler to the neighbourhood of Cape Kanin in October 1935.

The fishing took place further east than in the previous year, the shallow banks near Kanin and Kolgujew were also somewhat more heavily fished on account of the better haddock catches. The edges of the banks, however, were most frequently subject to fishing, as good catches of cod were to be made there. Near the Bear Island the fishing season finished comparatively early due to the deteriorating conditions.

During the autumn, 1935, no important change has taken place as compared to last year. The value of the fishery seems, generally, to have improved, so that a considerable increase of the fishery, also off Bear Island, may be anticipated, as against 1934.

The following publication has been issued in 1935:

Lundbeck, J.: "Die Fangerträge in der Barentssee, an der Bäreninsel und an der Norwegischen Küste in der Fangzeit 1934—1935." Deutsche Fischerei Rundschau, Jahrg. 1935, Heft 21, S. 484.

Norway.

The Norwegian institutions which have carried out fishery or oceanographical work in the North-Eastern Area in 1935 were: the research department of the Fisheries Directorate with its branch, the Flødevigen Sea Fish Hatchery (near Arendal), the Tromsø Museum, Tromsø, and the Geophysical Institute of the Bergen Museum, Bergen. The work of these institutions is reviewed here under similar headings as those decided upon in 1934 by the Northern North Sea Committee (see the Adm. Rep. for 1934—35, p.21).

1. Work at sea and hydrography.

A detailed report has been rendered to the Hydrographical Committee for inclusion in its report to which the reader is referred: Here a few general remarks will suffice.

The Fisheries Directorate had its research vessel, the "Johan Hjort", in commission from Jan. 17th until Nov. 21st and the smaller vessel, the "Virgo", for shorter periods while the vessel of the Geophysical Institute, the "Armauer Hansen", was hired for 4 cruises of one to four weeks' duration. —

The Flødevigen Hatchery carried out hydrographical investigations in inshore and coastal waters along the south coast by means of its research vessel, the "Ossian Sars", in all 139 stations being investigated.

On six steamship lines (from Bergen to Reykjavik, Faskrudsfjord, Rotterdam, Newcastle, Oslo and Kirkenes) thermographs recording the surface temperature were run continuously and samples for salinity collected four times during the year. The two last named services were started in 1935. The thermograms from routes to Iceland, Holland and England have been redrawn as usual by the Service Hydrographique of the International Council and copies may be had on demand from Copenhagen. Summary-thermograms will appear again this year in the Bulletin Hydrographique for the year 1935.

At three localities on the coast arrangements have been made earlier (1934) with local people for making deep sea observations at regular intervals and this service has been continued and will be extended in 1936 by the addition of a fourth station of this kind. Each station is supplied with a portable hand winch and meter wheel and two reversing water bottles, each with two thermometers, the whole outfit adapted to be used on a small motor launch or cutter.

The four localities are: (1) Sognesjøen, lat 61°, max. obs. depth 300 m., (2) Skråven, lat 68° (West Fjord), max. obs. depth 300 m., (3) Eggum, lat. 68° (outside Lofoten), max. obs. depth 200 m., (4) Ingøy (new), lat. 71°, long. 24° E., max. obs. depth 300 m.

The Tromsø Museum continued its routine work of observation at 7 localities in the Tromsø region. These seven stations were visited monthly by the vessel of the Museum (the "Sparre Schneider"). In the spring a special cruise was carried out on behalf of the Fisheries Directorate by means of a fishing vessel hired for the purpose.

The Geophysical Institute, Bergen, continued its routine work on the general hydrography of the West country fjords and on currents and internal waves, and also carried out observations on the penetration into the sea of the radiation from space.

2. Plankton.

The Fisheries Directorate collected zooplankton on all cruises, in all 76 horizontal hauls with the egg-net (silk 0, diam. 1 m.) and 200 vertical hauls (zooplankton net (silk 8, diam. 72 cm.)). During its cruises the "Ossian Sars" of the Flødevigen Hatchery made 198 hauls with the egg-net and 95 hauls with a 2 m. young-fish-net.

The Tromsø Museum made regular surface hauls with the egg-net at each of the monthly visits to stations and generally also vertical hauls with the same net. Water samples for the study of the microplankton were collected, in all 167 samples, maximum depth 75 m.

3. Fishing Technique.

At the beginning of the year the Fisheries Directorate had its cutter, the "Johan Hjort", fitted with an echo sounding gear (the Admiralty magnetostriction supersonic recording pattern) and by means of this apparatus series of investigations were carried out during the **Lofoten spring cod fishery.** The observations proved very successful in revealing interesting points about the behaviour of the spawning fish and are promising not only with regard to future fishery research but also by the prospect held out of possible modifications of fishery technique and fishery supervision. Research and experiments to this end will be continued in 1936.

Also **sprat** was detected by means of the echo sounder on the west coast in places where the occurrence of this fish was proved by fishing.

The systematic trap fishing for cod carried out by the Flødevigen Hatchery since 1922 shows decreasing output per fishing unit during the last ten years. This also was the case with the systematic fishing for the 0-group with hand seine at selected localities along the shores. This latter investigation has been continued since 1903.

4. Biology of Fish etc.

The Directorate of Fisheries.

Cod. During the winter fisheries for spawning cod of the Arcto-Norwegian stock, fish measuring and otolith collecting gangs were stationed at Ålesund and Bjørnsund in the Møre district, at Værøy, Balstad, Kabelvåg and Kjeøy in Lofoten and at Gryllefjord on the Senja island, — and during the spring fishing for immature and spent fish at Finmark such sampling was done at Ingøy, Mehamn, Berlevåg and Vardø. A total of about 133 thousand specimens were measured and otoliths were collected from about 4000 in addition to a representative material for vertebral counts and other biometrical investigations.

The Flødevig Hatchery has collected material

of the local south coast cod stocks at three places all the year round.

Herring. Of large and spring herring 56 samples (nearly 10,000 specimens) were collected, for age determination and vertebral counts of each specimen, and in the same way 15 samples of small and fat herrings were treated. In addition some samples from Iceland and from the Viking Bank have been examined.

Cruises with the principal object of locating the spawning areas of herring were carried out from Feb. 11th to Apr. 2nd on the west coast and in the north country from Apr. 5th to May 3rd. In the latter region spawning was detected in the vicinity of Harstad and on the Helgeland coast. For the first time a representative material was collected of the North Norwegian spring herring stock.

Plaice. Investigations were carried out according to widened plans on the stock of plaice on the coast from Stavanger to Finmark with special attention paid to the Trondheim fjord. The material was collected by means of the Danish seine and hand seine and samples were also obtained from the catch of the commercial seiners, from the young-fish localities in shallow water as well as the seining areas farther from the shore. The characters investigated were age, growth, vertebral and anal-fin ray counts, spawning, and nutrition.

Experiments on the **crossing of plaice and flounder** were successfully carried out on the premises of the Trondheim biological Station with the object of evaluating the effect of plaice hatching. The plaice-flounder hybrids were liberated with pure-bred plaice fry and their reappearance (or otherwise) is thought to afford a means of testing the effect of plaice hatching such as has been practised for a long series of years.

Simultaneous with this work on crossing also investigations on the susceptibility of plaice eggs to various influences were carried out.

A service of periodical fishing for small plaice (0-group) all the year round was started in the autumn at Storvik in Gildeskål, Nordland, a typical fine-sand beach locality with conditions suitable for young plaice at a variety of depths. Fourteen suitable localities in the same district, which occupies a central position on the Norwegian coast, has been fished for 0-group plaice for the last two years and this will be continued every autumn.

Sprat. Samples of the commercial catches were collected as in previous years since 1908 for analysis of age. In 1935 the stock fished upon was of very uneven size composition owing to the presence also of 2-year-old fish, partly with maturing sexual products.

Oyster. Experiments with rearing of oyster spats were carried out at the Flødevigen Hatchery by means of a new salt water rock pond with an area of 2000 m.^{2} (max. depth 5 m. and 5400 m.^{3} content). In the autumn it was estimated that the pond contained about 2—400 thousands of young oysters of 2—5 cm. diameter.

Measurements of oyster in private cultures on the south coast during the summer.

Lobster. The rearing of lobster fry at Flødevigen Hatchery was hampered by the scarcity of berried females so that the output of 4th and 5th stage fry only reached a number of 26 thousands. They were liberated at three localities on the south coast. Arrangements were made at these places to ensure later on the ascertainment of the effect on the catches of marketable lobster.

The measurement of lobsters caught in the area were continued, lobsters caught below the legal size limit being also considered. It appears that the liability to be caught is very high in the very moment of passing the size limit. This is reflected in the recapture percentage of marked lobsters on the south coast, 44 % being recovered within a year.

List of **Norwegian papers** on investigations in the North-Eastern Area, published in 1935—36.

Devold, Finn: Flyndreeggenes ømfindtlighet. Medd. fra Trondhjems Biologiske Station, 1935.

Eggvin, Jens: Temperaturen i Vestfjorden under Lofotfisket 1935. Årsber. vedk. Norges Fiskerier, 1935, Nr. 2, p. 99 ff.

Rollefsen, Gunnar: Aldersundersøkelser (Age investigations). Ibidem, p. 92 ff.

— The Spawning Zone in Cod Otoliths and Prognosis of Stock. Fiskeridirektoratets Skrifter, Ser. Havunders. Rep. on Norw. Fishery and Mar. Invest., Vol. IV, No. 11. Bergen 1935.

Sivertsen, Erling: Torskens Gytning med særlig henblikk på den årlige cyklus i generationsorganernes tilstand. (The spawning of the cod, with special regard to state of generative organs). Ibidem, No. 10.

Sund, Oscar: Echo Sounding in Fishery Research. Nature, Vol. 135, p. 953, June 8, 1935.

— Torskebestanden i 1935 (The cod stock in 1935). Årsber. vedk. Norges Fiskerier, 1935, Nr. 2, p. 84 ff.

— Om iakttagelser ved hjelp av ekkolodd under skreifiske i Lofoten 1935. Ibidem, p. 89 ff.

Scotland (R. S. Clark).

Scottish investigations in the North-Eastern Area were limited to a short visit by the Scottish research vessel "Explorer" during April 1935 to the region of Bergen. General hydrographic and planktonic observations were then carried out within the Norwegian Deep at the following localities — 60°07′ N. 4°13′ E., rectangle J19c, and 60°45′ N. 3°47′ E., rectangle H20b. Trawling, hydrographic and planktonic surveys were also made along the eastern sector of the Northern North Sea plateau.

Herring.

As a result of the meeting of herring experts at Lowestoft in October 1935 arrangements have been made to obtain, if possible, samples of spawning herring from Viking Bank and Shetland waters during the period January to March to investigate the possibilities of exchange between Shetland and Norwegian herring populations.

As to Hydrography and Plankton: see respective Committee reports.

NORTH-WESTERN AREA

1935.

By

Å. Vedel Tåning.

The work carried out in the Area during the year 1935 followed the lines of investigations maintained for a period of years. Nearly all countries represented on the Committee have made contributions to the work in 1935; the reports received are given below. The loss of the "Dana" after a collision in fog in the North Sea on June 22nd, however, has prevented Denmark from carrying out the work planned for this research vessel, and the continuous work in progress was seriously restricted owing to the loss of the vessel, as a few investigations only could be arranged for later on in the year.

As to Hydrography and Plankton in the different waters: see the special reports of the respective Committees.

Denmark.

The loss of the "Dana" prevented the ordinary cruise in the North-Western Area to be carried out by a research vessel. Captain Alf Trolle RDN (ret.) generously placed his boat "Thor" at the disposal of the Danish Commission for the Study of the Sea, a motor-cutter well fitted for various marine investigations; the "Thor" carried out different kinds of work in Icelandic waters as well as in East-Greenland and in Faroese waters. A Faroese motor-boat ("Louise") was used in the spring in Faroe waters.

Faroes.

Late in March and in the beginning of April collection of herring fry was carried out in some fjords and off Suderø; the material has been included in a paper recently published; most of the material was taken east of Suderø.

100 surface drift bottles were liberated east of Suderø and on the Suderø Bank, about 25 % of which have been recovered, especially from the Shetlands and Norway.

Furthermore marking of spawning cod was carried out north of the Faroes; 250 specimens were liberated 16.3 % of which were recaptured up to January 1st, all recorded by English and Scottish trawlers from the Faroes and the Faroe Bank (one).

Collection of cod material from commercial catches for investigation of fluctuations in the stock has been continued (about 15,300 measurements and 1500 otoliths).

Iceland.

In the spring (April 13th—20th) 182 large cod were marked and liberated in Faxe Bay and off the Westmanna Island; late in May 481 specimens of codling were marked and liberated in the Faxe Bay. The results of marking experiments on cod in Icelandic waters during the years 1924—33 will be published as soon as possible.

Material for age-analyses has been collected in Faxe Bay from the Icelandic trawler "Geir" under the supervision of Mr. E. Bertelsen; samples of scales or otoliths of plaice, haddock, halibut and lemon sole were secured, and measurements made. Samples of plaice otoliths were collected by H.M.S. "Hvidbjørnen". Bottom sampling was carried out in the Hvalfjord (West-Iceland) and in the Isafjord (N.W.-Iceland) by the M/C "Thor" under the supervision of Mr. Bertelsen; a total of 117 samples were collected; as to plankton investigations and hydrography: see the report of the respective Committees.

"Fiskifélag Íslands" has continued work as in previous years (by Árni Friðriksson, M.A.); the following report has been received concerning this work.

Cod: 25,924 specimens from the commercial fishery were measured; 3229 age-analyses were carried out. Dominating year-classes 1922 and 1924, the last mentioned the most important in the warmer waters of Iceland. Besides the richest year-classes 1924 and 1922, the year-class 1926 was good in most parts of the warmer area, 1930 off the North and East coast and 1932 off the North coast. The year-class 1934 (I-group) was proved very rich on the East coast, partly so also on the North coast.

Herring: With the herring trawl (headline 90 feet) 92 hauls were made in the area from Eystra Horn to Snæfellsnes in the period March 31st to May 27th; as also some 25 hauls off the North coast in August. The hauls gave no positive results as to herring.

6186 herring have been measured and a large part of this material has been investigated as to weight, maturity, fat and sex. Samples of scales were collected. This material was collected from April 24th to December 14th off the south, the southwest and the north coasts, in addition: some few, smaller samples from the northern part of the east coast. The catches off the north coast in June-August were principally spring spawning herring; on the other hand the catches from the south coast had in April and May 8.3—10.5 % spring herring only, and in July—December 30—68 % in the warm area of Iceland.

Quantitative investigations on the stomach content of herring were carried out; the result showed that up to about July 20th the stomachs contained more material than usual, after that date less material, and in August even less than half the ordinary quantity.

Plankton: 25 hauls were made with Prof. HARDY's Plankton Indicator along the whole north coast in August. Excepting a few localities copepods were present in much smaller quantities than usual; the copepods were taken for the greater part at the surface over-night, and not in the morning and in the evening as in previous years.

Bottom-sampling. The Petersen 0.2 m². grab was used during the cruise in March—April; the material has been handed over to Dr. R. SPÄRCK for treatment.

Hydrography: Different sections were carried out in March—April off the south coast, serial temperature observations only taken. Furthermore: sections on other coasts in addition to surface temperatures in the whole area investigated.

Prawns: Preliminary investigations on *Pandalus borealis* (and *Pandalus montagui*) have been commenced. A prawn fishery has been started in Isafjord, and other localities will probably take up this fishery. The investigation on the south coast has shown that the average length here is 12.49 cm. (the spine included), the average weight 7.4 gr. Off the south coast eggs, not yet hatched, were found in February, eggs containing embryos with eyes in April.

Denmark Strait.

No investigations were carried out this year in the open waters of the Denmark Strait.

Greenland.

East-Greenland: Various collections were made by the M/C "Thor" in the area south of Tingmiarmiut; bottom-sampling was especially carried out by Mr. E. BERTELSEN.

West-Greenland: Professor AD. S. JENSEN, fishery adviser to the "Grønlands Styrelse", has given the following survey of the work carried out in the coastal waters of West-Greenland during 1935.

In the summer 1935, from May to the end of September, the following work has been carried out chiefly from the motor-boat "Umarissok" (Magister PAUL M. HANSEN).

From the colony Godthaab (about 64° N. Lat.) to the Umanakfjord (about 71° N. Lat.) **plankton hauls** with a 1 m. ringtrawl have been made for fish fry during the whole period of the investigations.

A total of 553 specimens of **cod** has been marked. Of these a number (about 100) of spawning cod were marked in the Godthaabsfjord during May. The rest was marked in August—September in the Disco Bay. This is the first time cod have been marked so far north in Greenland waters.

For age-determinations and investigations of the fluctuation in the stock of cod material has been collected consisting of about 5000 otoliths and including measurements and sex-determinations. The samples have been collected on the different fishery stations at different times of the season. A material of measurements and otoliths of **halibut**, totalling 150, was collected at the fishery stations Kangamiut and Holstensborg.

The youngest year-classes of cod have been fished for with the eel hand seine all over the territory investigated. Finally a Johansen young fish trawl has been used at localities where the bottom conditions were favourable.

Marking of **Greenland halibut** has been tried for the first time. A total of 500 has been marked. About 100 were marked in the Godthaabfjord (about 64° N. Lat.) and about 400 at Jacobshavn (about 69°10′ N. Lat.). Of the last mentioned about 20 have been recaptured near the place of liberation shortly after the marking. About 300 measurements and otoliths have been taken for age-determinations of the Greenland halibut.

By the commercial fishery with trawl for **deep sea prawns** (*Pandalus borealis*) in the Amerdlok- and the Ikertokfjord a material of Lycods, Liparis and other species has been preserved for closer investigations.

Material of **capelin** (*Mallotus*) has been collected from the Ikertokfjord for age and race-determination.

Measurements of temperatures from the surface to 300 m. depth have been recorded at different localities of the whole area in which investigations have been carried out by the motor-boat "Umarissok".

On the offshore banks marking of 182 **cod** has been made by Skipper ALFR. EGHOLM of the Faroe cutter "Suduroy", and furthermore some 1700 measurements and 300 otoliths of cod have been secured.

As in the previous years many recaptures have been recorded from Icelandic waters; the following numbers of marked Greenland cod were obtained in 1935 in Icelandic waters.

Year of Marking	Marked in W. Greenland	Marked in E. Greenland
1929	2	
1930	7	1
1931	3	
1932	8	
1933	4	7
1934	20	
Total	44	8

Cf. Hansen, Jensen and Tåning: Cod Marking Experiments in the waters of Greenland 1924—1933 pp. 64—65, p. 89.

Whales: At Greenland the Danish whale boat "Sonja" caught 29 whales in 1935 (23 fin whales and 6 humpbacks).

At the Faroes Lopra Whaling Station (2 whale boats) in 1935 caught 88 whales (75 fin whales, 3 sei whales, 3 blue whales, 2 humpbacks and 5 sperm whales).

England.

Measurements of haddock and plaice with samples of scales and otoliths of Icelandic commercial catches (Grimsby).

France.

No work in 1935.

Germany.

"Deutsche Seewarte", Hamburg, "Institut für Meereskunde", Berlin, the laboratory of Professor Hentschel ("Hydrobiologische Abteilung des Zoologischen Staatsinstituts", Hamburg) and the laboratories for fishery investigations of the "Biologische Anstalt", Helgoland, and the "Institut für Seefischerei", Wesermünde, have carried out work in the North Western Area during 1935.

1. In 1935 the survey vessel "Meteor" made two cruises where an oceanographical working programme could be accomplished simultaneous with the inspection of the fishery.

During the first cruise (Febr. 19th to March 30th) 12 oceanographical stations were worked, chiefly along the 45° W. Long. from Cape Farewell to about 50° N. Lat., an undertaking which partly completed the investigations of the "Institut für Meereskunde", arried out from the "Meteor" since 1929 south-west of Iceland in the East-Greenland current and adjacent waters. The echo-sounder proved that the ridge which was supposed to form a connection between the Newfoundland Bank and the Reykjanes-ridge does not exist. At some places only the bottom rises as far as 3800 m. while the rest of the area has an average depth of more than 4000 m. The oceanographical members of the cruise were Professor Defant, Dr. Böhnecke, Dr. Dietrich ("Institut für Meereskunde", Berlin), Dr. Wattenberg, Kiel.

The second cruise (1. X.—16. XI. 35) took place to the area east of Iceland completing the investigations of the "Deutsche Seewarte" carried out 1933 by the "Meteor". Three sections were made through the East Iceland Current viz. from the East coast of Iceland towards to the Norwegian Deep and Jan Mayen respectively. Further a section from Jan Mayen to the Bear Island was made and the ridge between the Norwegian and the Greenland Deeps was thereby crossed several times; within the areas investigated a ridge with less than 2000 m. depth was ascertained; in the Norwegian Deep greater depths (up to 4000 m.) than formerly known were recorded. In total 34 stations were worked. The oceanographical members of the cruise were Professor Schulz, Dr. Schumacher, Dr. Kalle, Dr. Goedecke ("Deutsche Seewarte", Hamburg). (B. Schulz).

2. "Die Hydrobiologische Abteilung des Zoologischen Staatsinstituts" in Hamburg has carried out the following investigations:

Prof. E. Hentschel and Dr. A. Meschkat were onboard the survey vessel "Meteor" from mid-February to the end of March on a cruise to the Westmanna Islands, where they stayed for 25 days. Between the Shetlands and Iceland as also along the south coast of Iceland numerous quantitative plankton samples were collected from the surface with a gauze sieve, partly along the sections recommended at the meeting in Copenhagen 1934 (see Rapp. et Proc.-Verb., Vol. LXXXIX, I, p. 27). Other samples were taken near the Westmanna Island. The total number of plankton samples was 255. Furthermore, 1245 stomach contents of large Cod were investigated on the Westmanna Islands. Also the stomach contents of the animals (Crustaceans etc.) eaten by the cod were studied. Two papers were published on the results from the voyage: "Über das Winterplankton im Süden von Island" and "Untersuchungen über den Aufbau der Kabeljaunahrung im Bereich der Westmannainseln im März 1935" (Scientific Rep. North-Western Area Committee, Rapp. et Proc.-Verb., Vol. XCIX, 1936).

From the beginning of October to mid-November Dr. A. Meschkat travelled onboard the survey vessel "Meteor", which under the leadership of Professor B. Schulz carried out a cruise to the Faroes, Iceland, Jan Mayen and Bear Island. Quantitative surface samples were collected from the Shetlands to Iceland, around Iceland, on three principal sections east of Iceland, and between Iceland and Jan Mayen, as also along the rest of the route to Tromsø; a total of 310 samples were collected and are at present being investigated. (E. Hentschel).

3. Regular investigation of the market landings from German fishing vessels working off Iceland is planned but has not yet been commenced. Meanwhile, measurements on a small scale only have been made on 2645 specimens (= 8840 kg.) from 11 catches of fish, by the "Biologische Anstalt, Helgoland" and by the "Institut für Seefischerei" in Wesermünde. The individual weight of most of these fish was determined. Such measurements are to be extended considerably and are to form the base of calculating the number of fish from weights. Furthermore seasonal and other changes in the length/weight relation are to be investigated.

The new statistical census introduced has made it possible steadily to improve and almost to perfect the collection of information as to fishing-grounds and days' fishing from the landings by German fishing vessels arriving from Iceland. In this way it is possible

to follow the course of the German fishery in the Icelandic waters and to determine the yield of the different fishing-grounds and their seasonal fluctuations. (A. Hagmeier.)

Norway.

The surface thermograph service of the "Fisheries Directorate" on the two Norwegian liners "Lyra" and "Nova", between Bergen and Reykjavik, resp. Faskrudsfjord (and from Faskrudsfjord via all northern ports to Reykjavik) was continued, a few of the trips of the "Nova", however, were cancelled. The "Lyra" made 26 trips (thus 52 crossings), the "Nova" 8 trips only. On one of the crossings in each of the months February, May, August, and November samples for chlorinity were collected. Some results have been published in the "Bulletin Hydrographique" for 1935.

The Svalbard Office organised, on the "Korsvik" fishing expedition, sounding work in the Baffins Strait. The "Korsvik" was fitted with an Admiralty Echo Sounder. In charge of the sounding work was Capt. von Krogh who also made use of a motor-dory fitted with a Lucas sounding machine when the "Korsvik" was at anchor. The 31 anchorage stations were carefully determined astronomically by Capt. von Krogh and line sounding series in many directions from the mother ship were executed within a radius of 15 miles. The length of echo-sounded courses totalled 2760 miles, of line-sounded courses 225 miles and the 300-fathom contour was determined in a length of 520 miles (See: Norges Svalbard og Ishavsundersøkelser, Meddelelse Nr. 32, also in Norsk Geogr. Tidsskr., Vol. V, 8, Oslo 1935). (Oscar Sund.)

Scotland.

In the month of June the "Explorer" crossed the Faroe-Shetland Channel between Flugga (C20b, 60°53′ N. 1°06′ W.) and Nolsö (XX23d, 62°00′ N. 6°12′ W.) and returned by Faroe Bank and the Wyville Thomson Ridge to the Butt of Lewis. The Faroes were also circled. General trawling, hydrographic and planktonic observations were carried out at fixed stations on the route. **Herring larvae** were secured at the following localities by one-metre horizontal ring net.

Date	Rectangle	Depth	16—20 mm.	21—25 mm.
5 June	XX17a	0	—	2
		50	2	6
	WW18d	50	—	1
		100	—	2
6 —	WW18b	100	—	1
11 —	WW22a	50	—	2
		100	—	13

The larvæ captured at rectangles XX17a and WW18b and d in the neighbourhood of the Wyville Thomson Ridge, just on its southern boundary, suggest that these were derived from hatching localities farther south towards the western side of Lewis, probably from the Flannan Island area. This dispersal over the edge of the plateau may explain the captures in a previous year (1931) when larvæ were taken in the region of Faroe Bank.

Trawling observations were carried out round the Faroes and on Faroe Bank. The catches of **haddock** were dominated by fish of a modal size of 16—18 cm., belonging to the year-class 1934. This year-class was much better represented than in North Sea catches and again emphasised that the haddock stock at Faroe forms a separate community. The percentage captures of one-year-old haddock, year-class 1934, comprised about 60 % of the total haddock catches on Faroe Bank and at the Faroes. The 1932 year-class was next in order of precedence and formed about 35 % of the total catches. This latter year-class is also poorly represented in the North Sea. The brood of the year (1935) occurred in the catches immediately N.W. of the Faroes. The range in sizes of one-year-old haddock varied from east to west of the Faroes, being larger on the west side.

About 100 **lemon soles** were marked and liberated off Myggenaes, Svinö, and Fuglö, and returns which have been made by commercial vessels from these waters show little movement.

The area of greatest density of **calanus** was along the eastern edge of the Faroe-Shetland Channel, and especially in the region N.W. of the Shetlands. Within the deeper waters of the Faroe-Shetland Channel, calanus was poorly represented in the surface layers but was abundant in the lower strata from 50 to 100 metres. Around the Faroes calanus was poorly represented in the collections.

As to **Hydrography**: see Hydrographic Committee report. (R. S. Clark.)

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PLATEAU CONTINENTAL ATLANTIQUE

1935.

(Atlantic Slope).

Par

Ed. le Danois.

1935	Grande Bretagne	Irlande	France	Espagne	Portugal
Janvier	Salpa	....	....	....	....
Février	Salpa	Muirchu	....	....	....
Mars	Salpa	....	....	....	....
Avril	Salpa	....	Quentin-Roosevelt	....	....
Mai	Salpa	Muirchu	Quentin-Roosevelt Président Th. Tissier	....	....
Juin	Salpa	....	Président Th. Tissier	....	....
Juillet	Salpa	....	Président Th. Tissier	....	....
Août	Salpa	Muirchu	Pourquoi-Pas? Ailette	....	....
Septembre	Salpa	....	Ailette	....	....
Octobre	Salpa	....	Ville d'Ys	....	....
Novembre	Salpa	....	....	....	....
Décembre	Salpa	....	....	....	....

Les recherches effectuées dans la zone d'étude du Comité peuvent être résumées de la façon suivante:

France:

Le navire "Président Théodore Tissier" a effectué en 1935 une croisière du 8 Mai au 15 Juillet dans le Golfe de Gascogne, spécialement destinée à l'étude des conditions de la pêche de la sardine et du germon et à des recherches de cartographie sous-marine.

D'autre part, le navire "Pourquoi-Pas?", sous la direction scientifique du Commandant Charcot, a traversé le secteur du Comité Atlantique en se rendant vers le Groënland oriental et en y pratiquant des stations océanographiques.

La Marine Nationale a apporté encore cette année sa collaboration aux travaux d'hydrologie. Les avisos "Quentin-Roosevelt" en Avril et Mai, et "Ailette", en Août et Septembre, ont pratiqué de nombreuses observations au sud de l'Irlande et dans le Golfe de Gascogne; enfin l'Aviso "Ville d'Ys" a établi une section hydrologique sur les bancs de Terre-Neuve, le long du 45° N., en Octobre.

Grande-Bretagne:

Le navire "H.M.S. Salpa" de la Marine Biological Association a effectué régulièrement des sorties mensuelles aux stations prévues par le programme du Comité du Plateau Continental Atlantique.

De nombreuses sorties des Représentants du Service des Pêches d'Angleterre ont permis de pratiquer à la mer des mensurations sur le merlu et la sardine de Cornouaille.

Etat-Libre d'Irlande:

Le navire "Muirchu" a effectué, en Février, Mai et Août, des croisières périodiques en conformité avec le programme du Comité et qui ont porté sur l'hydrologie et l'étude de plancton.

Espagne et Portugal.

Par suite de questions intérieures, les Gouvernements d'Espagne et de Portugal n'ont pu, en 1935, assurer de croisières dans le secteur d'études du Comité.

Pour la première fois depuis la création du Comité Continental Atlantique en 1920, je n'ai pas été à même de fournir un rapport concernant les observations effectuées en 1934. La parution régulière, dans le Bulletin hydrographique du Conseil, des observations faites dans le secteur d'études du Comité rend inutile une nouvelle publication de ces données dans le Rapport Atlantique. Je n'ai pu, d'autre part, obtenir de travaux concernant l'hydrologie, la biologie ou le plancton des divers États participants et ne pouvais rédiger un rapport avec le seul compte-rendu des recherches françaises qui sont appelées à paraître dans une publication nationale. Les données que j'ai jusqu'ici recueillies pour l'année 1935 sont également fort réduites et je me propose d'attirer l'attention du Comité sur ce ralentissement marqué de son activité.

COMITÉ ATLANTIQUE

1935.

par

Ed. le Danois.

Le Comité Atlantique, spécialement créé pour établir la liaison entre le Conseil International pour l'Exploration de la Mer et le Conseil International de Recherches des Pêcheries de l'Amérique du Nord, est, par contre, entré dans la voie des réalisations utiles par l'étude de problèmes communs aux deux côtés de l'Océan Atlantique.

Des recherches combinées des deux Conseils sur la prédominance de certaines classes de poissons comestibles, aussi bien du côté américain que du côté européen, font l'objet de rapports qui seront groupés à la prochaine séance du Comité.

Il serait important qu'un Représentant des Etats-Unis ou du Canada assistât à cette séance pour résumer l'œuvre accomplie de ce point de vue dans l'Atlantique occidental.

COMBINED NORTH SEA AND EASTERN CHANNEL COMMITTEE

1935.

By

G. Gilson.

Organising work for the contemplated survey of the Channel—North Sea region has been delayed for different reasons, the major one being that everybody concerned are engaged on routine work and are all deeply engaged on special researches that can neither be stopped nor part with any portion of their means of action. — Meanwhile we feel more than ever impressed by the excessive waste of time, and money involved every year, in the collection of a great wealth of data — not always made use of —, in the intermediate area Channel—North Sea. This great loss of time and means of work absorbed by efforts, unconnected in time and space, could be notably lessened by continuous observation of the ever changing physical and biological conditions in our small but very interesting expanse of the sea. Besides, modern methods require the association of workers, and this is sufficient to impose the necessity of cooperative investigation in the present case.

It has been suggested, and I strongly support the idea, that, instead of waiting until the complete scheme is organised, partial work be carried on by certain groups of workers while pursuing their special investigations in the region. Without great alteration of their own plan of work they could sometimes do, and plot on charts, some very useful observations in concordance with the preconceived plan of a general survey, and so prepare the ways and means for the complete regular and periodical exploration of the egion. It is partly in view of facilitating such preliminary work that I have prepared the special chart with vertical sections which has been distributed by the Secretary. A large number of copies of this chart being printed it will be possible to use a copy for plotting on the chart or on the sections data collected during each of the cruises. The sections on the chart all cross the tidal currents at almost right angles and have been selected after nautical considerations: as far as possible passing in the vicinity of lightships and buoys. These lines could easily be altered if more convenient for practial or scientific reasons. If found advisable, longitudinal lines running along the deep valleys of the bottom, shown in the vertical sections, could be added on the chart. An abbreviated programme of work could be accepted for this initial kind of researches, including only temperature observations and collection of water and plankton samples at certain points of the lines adopted as fixed stations. If possible, a few fishing operations, especially short trawlings ought also be done across the lines. In the meanwhile data could be obtained from the lightships doing continuous observations and added to those made on board research vessels. Such limited programme does not seem beyond the possibilities of a research expedition provided with the ordinary means of marine investigation. I think that some of the existing laboratories would accept the task of rapidly working out the material collected, each within its own speciality and according to means. Samples of water could be sent to one place for analysis and plankton to another, perhaps after the picking out large forms of crustacea etc. — Obviously, no effective result of even a preliminary attempt to a general survey could be expected without intervention of some centralising organism collecting all data obtained, for tabulation and plotting on synthetical charts and sections and, if sufficient, to draw a partial sketch of the hydrographical and biological situation at the time. Perhaps the Bureau of the Council would take in hands the formation of some central Office composed of two or three competent persons.

In Belgium, we have been trying to carry out a small part of the programme by doing once a month the adopted cross line Deal—Gravelines with four hydrographical and plankton stations, and we hope to be able to do more work as soon as we obtain improved means of work, until other countries have decided to tackle the complete scheme of the enterprise.

Belgium.

Monthly crossings with the Fishery cruiser "Zinnia" on the line Deal—Gravelines. Temperature observations from surface to bottom. Samples of water and of plankton with vertical net and with large net special for collecting quite near the bottom. Continuous observations of the annual concentration of spent herring along the coast during the whole of the fishing season. Biological scale completed. Similar observations on herring from the Smalls region and on the sprat fishery. Continuation and termination of researches on the destruction of young fish, — memoir just printed. Researches on shrimp fishery. Food of fishes. Laboratory investigations on air bladder of clupeids.

England.

See report of Southern North Sea Committee.

France.

See report of Southern North Sea Committee.

Germany.

Researches have been carried on in the intermediate region Channel—North Sea, in January and in November—December, on fry, especially herring larvae, and on micro and macroplankton, as well as on the hydrographical conditions there prevailing. In January observations have supplied indications as to the fate of the brood of the herring of the Downs of November 1934. The larvae of the Hinder region have been carried East—North East towards the Dutch coast. Younger larvae seemingly hatched in December were found in the powerful volume of water flowing from the Channel into the North Sea. Very young larvae, partly still with yolk remnants, were encountered in large numbers (2300 per cubic meter) near the French coastal banks, and in lesser number on the Flemish banks. In November—December herring larvae already without yolk were observed in the vicinity of the North Hinder in the astonishing number of 4600 per square meter of surface. — The spawning of the plaice was definitely more advanced than that of the same season in 1934.

Holland.

Examination of about 3200 herrings from the Flemish Banks — length, sex, maturity, age, race — from end of October 1935 until end of February 1936.

Herrings of 1929, 6 years old, outnumbered by far those of the year 1930 which was especially poor. That this particularly successful brood of 1929, nevertheless, fell short of our forecast made in the spring 1935 — when it was expected to attain 34 % of the catch — is due to the extraordinary abundance of classes 3 and 4. (Balancing of percentages.)

The now 4 years old fishes constituted $^1/_3$ of the whole catch. They have been already mentioned as a particularly abundant brood in the preceding season, when 3 years of age, by LE GALL, and by GILSON in the spent herring community along the French-Belgian coast. Now another abundant brood, 3 years old, appears for the first time in the catches — a fact that could not have been foreseen. It is the numerical preponderance of the broods 1932 and 1931 that renders my forecast attempted for the autumn 1935 partly faulty. (Rapp. et Proc.-Verb. Vol. XCIV, 3, p. 72—73.)

Besides, more than 6600 herrings were measured only. The average length was 24.21 cm.

Age	3	4	5	6	7	8	9	10	?
Year of birth	1932	1931	1930	1929	1928	1927	1926	1925	
					Percentages				
1.X.1935—15.XII.1935	18.6	30.6	12.9	21.9	8.5	5.0	1.6	0.4	0.4
No. exam.: 2040									
1.I.1936—29.II.1936	16.2	33.2	9.7	28.9	7.4	2.8	1.0	0.2	0.6
No. exam.: 1198									

NORTHERN NORTH SEA

1935.

By

ROBERT S. CLARK.

INTRODUCTION

The spring-summer influx of Atlantic water into the Northern North Sea appeared to be weaker than during the previous four years, and the maximum occurred during the latter half of June about two months later than usual. A greatly increased resistance to the north-easterly progress of the Atlantic current in the Faroe-Shetland Channel resulted in the deflection of the bulk of the water composing this current towards Faroe Bank and Faroe from the region of Wyville Thomson Ridge. This resistance was due primarily to an abnormally strong Norwegian Sea circulation which reached farther to the south than usual. The effect of these conditions would be to diminish the intensity and probably also the volume of the Atlantic incursion into the region and to impede the passage of water in bulk northwards out of the North Sea along the Norwegian coast. This explanation receives support from the decline in the number of surface drift bottle recoveries from the Northern Norwegian coast and from the early extensive westerly expansion of Baltic water over the surface of the North Sea. A deflection of a large mass of Atlantic water towards the West Coast of Scotland between Barra Head and the north coast of Ireland appears also to have taken place as a result of the check to the normal north-easterly flow of oceanic water.

As a result of the peculiar hydrographic conditions, the composition of the plankton was quite different in the western and eastern sectors of the North Sea. During spring and summer phytoplankton was more abundant east of the prime meridian. Older stages of **Calanus** were concentrated more in the western and

younger stages in the eastern sector. Exotic forms like Salps and Doliolids appeared in June at Wyville Thomson Ridge and north-west of the Shetlands. They were next observed in September at Fair Isle, Shetlands and eastwards to Viking Bank, but except for a small patch of Doliolids north-east of Buchan Deep, they were absent south of Fair Isle. The deflection of Atlantic water towards the west coast of Scotland was evidenced by the occurrence in the area south of Barra of numerous *Velella*, *Janthina*, *Lepas fascicularis*, and *Sthenoteuthis*. Though many of these exotic forms were washed up on the Hebrides, none seemed to find their way round the north coast towards the northern gateways to the North Sea. The dispersal of **herring larvae** from the usual autumn spawning grounds along the east coast of Scotland appeared to be normal. In contrast to the previous year, they were retained within the East Scottish Bight and invaded the Forth estuary in large numbers during the late autumn months.

Predominant year-classes of **herring** during the year were fish with 6 winter rings, year-class autumn 1928; fish with 3 and 5 winter rings among late autumn spawners, and fish with 4 winter rings, year-class 1931 among spring spawners. The Forth fishery was one of the largest for many years both in numbers and in quality. Racial investigations indicate that this was due largely to an invasion by shoals of large herring similar in morphological characteristics to the spring spawning herring of the north of Scotland. The Clyde fishery was only moderately successful and the proportion of small fish was larger than usual. This has been explained as being due to the retiral from the estuary of older fish belonging to the successful year-classes 1928 and 1931 and to the presence of the moderately good young brood of 1933. Recruitment from the year-classes 1929, 1930 and 1932 was poor.

The most promising feature of the **haddock** investigations was the appearance in large numbers of the brood of the year which is strongly suggestive of good survival. The actual strength of the new recruitment, however, cannot be gauged until the spring-summer of 1936. The previous year-class (1934) was relatively poor, but the 1933 brood was moderately successful. The year-class 1932 did not contribute largely to the stock, while the numbers of the successful 1931 brood have now been subjected to considerable attrition. The numbers of older haddock in the catches were relatively very few.

Investigations on the small **plaice** populations within territorial waters have shown no diminution in the strength of the annual recruitment. If the estimate of a relatively strong representation by the brood of the year (1935) be confirmed by the catches during 1936, there will have been three good survival year-classes in succession. This augurs well for the fishery during the next few years. An experiment on the transplantation of maturing plaice from the Southern North Sea to the East Coast of Scotland was moderately successful. The position of capture of the few fish so far recovered indicated that these fish on moving offshore to spawn had followed the route taken by the indigenous population. From the investigations so far made there appears to have been no great reduction in the numbers of marketable sized plaice on the inshore grounds of the East Coast of Scotland, though there is evidence of a decline in the numbers of the older components of the stock and a tendency for the fishery to be dependent on the younger groups between two and three years of age.

A paper on Marked **Lemon Soles** has just been published (Fisheries, Scotland. Sci. Invest. 1935. 1). A significant feature of the results is that brood recruitment is not so dependent on one particular year-class as in the haddock.

Experiments on the rearing of **lobsters** under artificial conditions have been continued at the Scottish Fishery Board's Laboratory at Nigg. These experiments have shown that small lobsters under four inches in length cast twice each year until a length of six inches is reached. Thereafter casting is an annual event until a length between nine and eleven inches is reached. Beyond this size, growth again slows down and casting takes place every second year or at longer intervals. The statistics of landings at selected localities round the Scottish coast continue to be collected in order to follow the effect of the fishery on the stock.

The reports of work done within the area by the participating countries have been compiled by their representatives on the Committee.

1. WORK AT SEA

Denmark.

Owing to the loss of the research vessel "Dana" no observations were made by Denmark in the area during 1935.

England.

The "George Bligh" visited the East Scottish coast in September and carried out trawling operations for plaice which were transplanted, marked, and liberated in the Southern North Sea. This was part of a joint experiment with Scotland when plaice captured in the Southern Bight were transferred to the East Coast of Scotland.

France.

April:	Cruise on the trawler "Vierge de Boulogne". Study of the fishing grounds in the region of Utsire. Hydrography. Plankton in relation to the fisheries. Bottom fauna. Measurements of Mackerel (1608), Hake (1353), Saithe, Cod, Herring, and Megrim. Examination of stomach contents and stage of maturity of the different species of fish.
May—August:	Cruises of the fishery patrol vessel "Ailette". Observations on the cod fishery at Iceland and on the her-

ring fisheries of the North Sea. Hydrographical observations were made at 66 stations.

May—October: Cruises of the fishery patrol vessel "Quentin Roosevelt". Observations on the cod fisheries of the Murman coast and on the North Sea herring fisheries. Ninety-five hydrographic stations were occupied.

Germany.

The German Fishery Protection Vessel "Elbe", operating from Hamburg, carried out observations from the end of July to the end of August in the region of the Fladen Ground and Bressay Shoal. The main object was to analyse samples of herring from the luggers and steamers, according to size, volume, weight, maturity, age, and number of vertebrae. The examination of this material was carried out in conjunction with the analyses of the market landings.

Holland.

The Fishery patrol vessel "Nautilus" made two cruises to the Northern North Sea during the period 20th June to 3rd August 1935 and carried out the usual hydrographic survey.

Norway.

A series of oceanographical sections was executed by the Fisheries Directorate somewhat in excess of the plans mentioned in last year's programme, partly by the Directorate's own vessel, the "Johan Hjort", partly by the "Armauer Hansen", which was hired for the purpose from the Bergen Geophysical Institute. The sections were as follows:—

Date	Cruise Profile	No. of Stations	Vessel
17/18 Jan.	Egersund, course 210°, 40 n. m.	8	"Johan Hjort"
5/6 April	Hellesoy to Balta Sound	17	"Armauer Hansen"
8 —	Sumburgh Head to North Ronaldshay	5	do.
13/14 —	Feistein (Stavanger) to Burra, Orkney, and return journey	27	do.
15 —	Egersund, 210°, 60 n. m. thence 270°, 54 n. m.	12	do.
21/22 Sept.	Hellesoy to Balta Sound	18	do.
24 —	Sumburgh Head to North Ronaldshay	5	do.
24/26 —	Feistein to Burra, Orkney	26	do.
2/3 Oct.	Egersund, 210°, 60 n. m.	7	do.
3/4 —	Slotteroy, 270°, 61 n. m.	7	do.

Scotland.

The following is a summary of the cruises of the research vessel "Explorer". General hydrographic, plankton and trawling observations were carried out at all stations on these cruises.

Feb.—March: North-western sector of the Northern North Sea.
Hydrographic and plankton conditions at the northern gateways. Distribution and frequency of occurrence of the different age groups of haddock.

April: 1) Northern North Sea.
2) Middle North Sea.
Extent of influx of Atlantic water. Herring spawning along eastern edge of the continental plateau. Survey of haddock stock on spawning grounds and relative strength of new recruitment.

May—June: Faroe-Shetland Channel. Faroes. Faroe Bank. Butt of Lewis. Minch. N. of Scotland.
Herring larvae in Faroese waters. Survey of fish stocks.

July: Sea of Hebrides. West Coast of Scotland. Clyde estuary. Inner Hebrides. Minch.
Census of fish stocks. Haddock populations on west coast.

August: Central and South-Eastern North Sea. Ling Bank. Great Fisher Bank. Danish coast. Dogger Bank. Forth.
Analysis of haddock stock. Transplantation of plaice.

Sept.—Oct.: North-Western North Sea. Shetlands. Orkneys.
Recession of Atlantic water. Position and extent of Northern Eddy system.
General survey of west Orkney inshore grounds.

November: Middle North Sea.
Hydrographic survey during transition to winter conditions. *Calanus* populations and dispersal of larval herrings. Survey of haddock broods and preliminary estimate of new recruitment. Coastal survey — plaice and herring.

Throughout the year, the motor vessel "Enid" investigated the bays and estuaries of the East Coast of Scotland. The main objects of these investigations were to analyse the small plaice populations, to survey the bottom fauna available as food, and to continue the examination of the stocks of adolescent herring.

2. HYDROGRAPHY

France.

Observations were carried out from April to October during a visit to the fishing grounds in the region of Utsire and throughout the period of the French North Sea herring fishery.

Holland.

Observations were taken during two cruises of the "Nautilus" to the Northern North Sea from 20th June to 3rd August.

Norway.

The surface thermograph service on the four lines previously worked from Bergen to Reykjavik and Faskrudsfjord in Iceland, to Newcastle and Rotterdam was continued regularly except the Faskrudsfjord service which was run only eight times instead of the normal twelve. The Reykjavik and Rotterdam services were run fortnightly, the Newcastle line weekly. Water samples were collected as previously on four runs in February, May, August and November.

Copies of the Thermograms, drawn to uniform scale and rectangular coordinates, are obtainable at the Bureau (Copenhagen). The data of the Reykjavik line thermograms have been treated by Captain NELLEMOSE and were presented in a condensed form in the last Hydrographical Bulletin.

Scotland.

A summary of the general conditions prevailing in the Scottish area appears under the report of the Hydrographic Committee.

3. PLANKTON

France.

Material was collected during the periodic visits to the North Sea, but so far no particular observations are available.

Scotland.

The investigations were concentrated largely on the biology of the Copepod *Calanus finmarchicus* and on the larval stages of the more important food fishes. The collections of microplankton by means of the standard vertical tow net were continued as in previous years. A paper by Dr. GIBBONS on "Copepod Crustacea, principally *Calanus finmarchicus*, collected by the "Explorer" in 1933" is in the Press. A report is in preparation on the collections during the two succeeding years. Salps and Doliolids, forms which are exotic to the area, occurred during the summer-autumn months chiefly in the north-western sector and did not penetrate in numbers further south than Fair Isle. They were not in such abundance as during the peak years 1921, 1925 and 1926, when the greater part of the northern area, including the Moray Firth, was flooded with these pelagic Tunicates. Their restricted distribution was apparently conditioned by a strong southerly extension of Polar water from the Norwegian Sea. Unusual occurrences of *Velella*, *Janthina*, *Lepas fascicularis* and *Sthenoteuthis* were noted on the west coast of Scotland and at the Hebrides, but these forms were not encountered along the north of Scotland or at the northern gateways to the North Sea. The occurrence in large numbers of these occasional immigrants along the west coast of Scotland appears to have had a direct relation with an abnormal inflow of oceanic water towards the west coast of Scotland between the north of Ireland and Barra.

Larval Herring hatched in the autumn of the previous year (1934) were taken in March and April at the Orkneys and Shetlands and in the region of Ling Bank. The occurrences of these "winter carry over" larvae at these localities are unusual and indicative of a reversal of the currents during the later months of the year (*vide* Hydrographic Report for 1934). The sizes ranged from 25 to 35 mm. during March and April, while the maximum size of the spring brood of the year (1935) was less than 15 mm. in March and 20 mm. in April. Spring larvae were obtained from March to June, when they disappeared from the catches in offshore waters. They were taken between the Butt of Lewis and Wyville Thomson Ridge, in the Minch, along the north of Scotland, at the Orkneys, Shetlands, Viking Bank, along the western edge of the Norwegian Deep, off Bergen, and in the region of the Firth of Forth. None was taken in the central area of the northern and middle North Sea. A few larvæ were taken in June to the west of the Faroes. Normally the production of spring larvae along the west coast of Scotland is on a large scale, but during July month when observations were carried out along the whole extent of this coast line, both on the outer and inner grounds, no herring larvae were secured in the plankton collections. Observations in this area in previous years have shown that the larvae have reached the scaled stage by this month and the small adolescent stages have been found close inshore beyond the reach of the larger research vessel. No larvae of autumn incidence were caught during August between the east coast of Scotland and the Danish coast. Sprat larvae, however, were encountered immediately east of the Tail End of the Dogger Bank. From September to November, herring larvae were taken from the Shetlands to the Firth of Forth as far eastwards as the prime meridian. They were present in large numbers within the estuary of the Forth during the later months of the year so that the normal drift of the larvæ had been in operation within the East Scottish Bight, as opposed to the unusual conditions at the same period during the previous year. The occurrence of larvae to the west of the Orkney-Shetland passage in September is indicative of autumn spawning along the north of Scotland.

Food of Herring. The study of the food of adult herring was continued. During the early feeding period Euphausids were of frequent occurrence forming, in this particular season, a proportion of the food equal to or even larger than *Calanus* in most of the samples taken up to the middle of June. *Thysanoessa*, *Nyctiphanes* and *Meganyctiphanes* were present in varying relative proportions. From then onwards Decapod larvae occurred in increasing numbers and the Euphausids became of minor importance. While the bulk of the food was Crustacean, plankton organisms other than Crustacea were predominant in occasional samples. This was particularly the case in the latter part of the season when *Clione* and *Limacina* were plentiful in the stomachs. Generally speaking, the samples were few in which *Calanus* was clearly the predominant organism.

4. FISHERIES

ngland.

The ichthyometric work at sea was continued and ncluded the measurements of 4459 Plaice, 53120 laddock, 13332 Cod, 56 Turbot, 6419 Whiting and 16 Hake. The haddock data were handed over as sual to Scotland for treatment.

rance.

During a cruise on the commercial trawler "Vierge e Boulogne" in April to the region of Utsire, measure- ents were taken of Mackerel (1608), Haddock (1353), aithe, Cod, Herring and Megrim.

ermany.

The compilation of lists of the catches of luggers om the records of the day books which had been terrupted for some years was resumed. The compila- on was carried out completely for the years 1931—933 and incompletely for 1934. Departing from the rmer method of presentation, the amounts and mber of the catches were combined in one list. In dition to monthly lists, yearly lists were also awn up.

In addition, statistical records were made of the urse of the Herring Trawl Fishery. The results, along ith a short summary of the composition of the oals, have already been published ("Der Fisch- arkt", 1936, No. 3).

cotland.

Statistics of landings of lobsters at selected localities the west, north and east coasts of Scotland have en continued and a close watch is being kept on e rational exploitation of the stock.

Fishing Technique.

olland.

Provisional experiments were made with a new avings Trawl and with the standard trawl with d-end of 24 rows per yard. Sufficient data were not tained to provide material for a report.

cotland.

Comparative experiments to define the sizes of addock and whiting captured by a commercial anish seine net with standard meshes in the retaining rtion of the net were undertaken during September the Moray Firth. Whiting were present on the ounds in enormous numbers, but unfortunately for e success of the operations a remarkable scarcity haddock was encountered. Under the circumstances, would be unsafe to draw definite conclusions. The zes of whiting ranged from 21 to 45 cm. and of addock from 15 to 55 cm. — the latter with gaps tween 17 and 25 cm. and 44 to 54 cm. The experi- ents will be repeated.

Comparative experiments were carried out during e year on equivalent mesh sizes in the bag and d-end of the cotton seine net and in the manilla d-end of the otter trawl.

5. FISH

(a) Herring.

France.

Observations on the Fladen and Utsire herrings were carried out regularly during the period of the French trawl herring fishery in these regions.

Germany.

Samples of herrings from the market and at sea were investigated according to size, volume, weight, maturity, age and vertebral counts. The main object of the investigations was to get some insight into the composition of the catches according to natural communities. In this respect it seemed particularly necessary to subject the determination of maturity to a close examination since without an exact determination of maturity, the natural communities cannot be recognised with sufficient accuracy. The maturity was first determined from the external characters as was formerly done. Weighings and measurements of the volume of the whole fish and also of the gonads were carried out and the percentage relationship of these to one another calculated. For exact weighing at sea when the ship is rolling, a special method was instituted. In addition, counting of the eggs was carried out. It has thus been proved that neither by calculating the relationship of the weight of the gonads to the total weight nor by the counting of the eggs can a more accurate method of determining the maturity be arrived at. One cannot simply establish for the herring a standard which will be generally valid; separate standards must be established in every case for herring of different origin. The chemical investigations which were carried out to determine the maturity stages gave likewise no positive result. In order to attain greater accuracy in determining the maturity from external characters it is recommended in particular determinations to restrict them to the females.

The investigations on the composition of the herring shoals were continued. A considerable change in the age and size compositions as compared with 1934 was found (cf. Dr. W. Erdmann, Der deutsche Schleppnetz Heringsfang 1935, "Der Fischmarkt", 1936, No. 3). Further there were indications that in the year 1935 a quickly growing herring has penetrated very far into the North Sea, partly as far as the Gut.

Norway.

A number of herring samples from the Viking Bank area has been analysed. The spawning places of Norwegian spring herring have been investigated.

Scotland.

Herring Ova. The records of "spawny haddocks" continue to be rendered by the fishermen. There has now accumulated a wealth of valuable material regarding the spawning places of herring in Scottish waters and the data are being prepared for publication. During the year (1935) the observed localities of

spawning were more or less normal, both during spring and autumn. The occurrence of spawny haddocks in the immediate neighbourhood of the Longstone during the second half of August is early for this region so that temperature and other conditions must have been suitable.

Adult Herring. The investigations have been carried out on the same extensive scale as in the previous year. All the important grounds visited by the herring drifters fishing from Scotland have been extensively sampled, and during the year over 18,000 herring were examined and counts of vertebrae and keeled scales were made in the case of 12,600 of that total. The fishing grounds extend around the entire Scottish coast and embrace the greater part of the Northern North Sea, so that the task of keeping touch with the shoals in the many diverse areas is a formidable one even when sampling is reduced to a minimum.

The objects of the work have been (a) to keep account of the age composition of the shoals and their fluctuations from year to year, (b) to establish the 'race' characters of the various communities and stocks found in Scottish waters and (c) to enlarge our knowledge of their movements. The vast amount of material already collected is being analysed and prepared by Dr. Wood for a comprehensive publication on the biology of the herring in Scottish waters.

Summer and Autumn Herring Fishery. 1935.

Age composition — North-Western North Sea.

The landings on the whole were fairly good and were in accordance with the forecast which had been made concerning the fishery. From early in June until near the end of July about 50 % of the fish landed at Scottish East Coast ports had three winter rings on the scales. This group was also fairly prominent at Shetland, but during the same period older herring, having from four to six winter rings, were also numerous in this area. At the approach of the spawning season very important changes took place in the age composition, particularly off the Scottish N.E. coast, where there was a very sharp increase in the number of fish with six winter rings which ultimately formed between 40 and 50 % of the spawning population. This latter group (year-class autumn 1928) has appeared in the catches regularly in July since 1932 and has done more than any other group to restore the Scottish summer herring fishery.

The Fladen Ground.

In July and August the samples, which consisted mainly of late autumn spawners, were very variable in their age composition, although generally three and five ring groups were dominant. As the season advanced these left the grounds and their place was taken by spring spawning fish from the north, the majority of which had four winter rings (year-class spring 1931) and autumn spents, from the coastal grounds, amongst which six ringers (year-class autumn 1928) were dominant.

Spring Fisheries.

Forth and Clyde.

During the spawning season in the spring of 1935 the spawning shoals in both areas consisted mainly of herring of the very successful year-class, spring 1931. In the Clyde, where fishing is carried on practically the whole year, this group disappeared completely from the catches at the close of the spawning season, and the fishery during the remainder of the year became entirely dependent on the adolescent 1933 year-class.

Racial Investigations.

Counts of vertebrae and keeled scales, K_2, have shown that the Scottish herring population includes three important stocks or races, each fluctuating in abundance independently of the other. These are: 1. Scottish Autumn Spawners, vertebrae 56.4, K_2 14.8; 2. Scottish Spring Spawners, vertebrae 57.0, K_2 13.8—14.2; and 3. Late Autumn Spawners which are present off the Scottish east and north-east coasts in June and July and on the Fladen Ground from July to September, vertebrae 56.5—56.6 and K_2 14.9—15.1.

The number of vertebrae in the third group could arise from a mixture of spring and autumn spawners. The high number of the K_2, however, shows definitely that this is not the case. The number of K_2 has proved to be of very great value as a distinguishing characteristic of different spawning communities of the same race or stock. For example, the communities which spawn in spring at Shetland, in the Clyde and in the Forth can be much more readily distinguished from each other by the number of their K_2 than by the number of their vertebrae, and amongst autumn spawners the small community which spawns on the east side of the Minch in August and September can be distinguished from the much bigger community of spawners of the North-Western North Sea only by the differences in the number of keeled scales.

(b) Haddock.

Scotland.

The present position of the haddock stock in the North Sea and adjacent waters has been clearly defined by the regular and intensive investigations carried out during the year. Recruitment in the North Sea during the three years previous to 1935 was found to be poor to moderate. The broods hatched in 1932 and 1934 were weakly represented in the catches by the research vessel during their first year of life, while subsequent captures by the research ship and by commercial vessels have confirmed the previous estimate that these year-classes have not contributed on a large scale to the replenishment of the stock of haddock in the North Sea. The year-class 1933 gave slightly better representation but the numbers were still far below those of the more successful brood of 1931 which was again far below that of 1928 — the most successful haddock brood in recent

ears. The year-class (1931) is now about five years ld and it has been subjected to considerable attrition hrough fishing operations since it entered the smallest arket category and especially since reaching aturity. The older year-classes of 1929 and 1930 ere poorly represented throughout so that with the shing out of the 1928 brood, the numbers of older addock were insignificant in the catches during the ear under review. Observations on the brood of the ear (1935) have so far shown that recruitment has en on a liberal scale and though it is still too early assess the relative strength of the survival, there e strong indications of a rich replenishment to the addock stock.

(c) Plaice.

cotland.

The investigations on the small plaice populations ithin the territorial waters of the East Coast of otland were continued during the year from the oard's motor research vessel "Enid". Twenty-one housand plaice were measured and about 75 % of ese were otolithed for age determination. Since ese observations were instituted in 1930, there ve been three good survival years, 1931, 1933, 1934, d there are indications from the catches during e latter half of 1935 when this brood entered into e "Enid"'s trawl catches that this year-class will so make a substantial contribution to the East ottish plaice stock. The outlook, therefore, for the shery in the immediate future seems to be quite omising. The investigations have again shown that ere are distinct differences in growth rate in the fferent bays along the coast and the causes of these riations are being examined more closely.

The age groups occurring within these territorial aters range from 0 to VI, with an occasional indidual up to VIII. Group I is immune from capture commercial vessels in permissible areas, except quick growing localities during the later months the year. Group II enters the smallest market tegory early in the year in good growth localities d 50 to 80 % of this group come under permissible nding size (23 cm.) towards the end of the year. e bulk of Group III and all older groups are of arketable size.

(d) Lemon Sole.

otland.

The biology of the lemon sole is being pursued ore intensively. A total of 17,000 fish has so far been amined. Age determinations have been made by ale readings. Considerable fluctuations in annual cruitment have been observed. The years 1921, 22, 1926 and 1930 showed good survival, while h hatched in 1924 and 1929 were poorly represented the catches. There are indications of variation in owth rate in the different areas of distribution. e bulk of lemon soles in the commercial catches s been composed of fish in their fifth and sixth ars. The oldest fish caught during the period under view ranged from 12 to 16 years. The distribution, frequencies of occurrence and growth rate of the larval forms are also receiving attention so that the spawning places may be defined and a possible "winter carry over" of the larval stages elucidated.

(e) Megrim.

France.

The biological study of the megrim was continued on the lines of last year's report.

6. SHELLFISH

(a) Lobsters.

Scotland.

Data regarding the sizes of lobsters landed at the selected creeks of Soay in Skye, Rousay at the Orkneys, and Burnmouth near to Berwick, were continued on the same lines as during the last four years. The progressive decline in the relative numbers of lobsters of 11 inches and over which were landed at Rousay and Burnmouth districts appears to have been arrested. The numbers of larger lobsters in the Soay district continued to fall off in spite of the fact that for some years none under 9 inches appears to have been marketed. These lobster returns from selected creeks indicate quite clearly the differences in the times of hatching and spawning and in the proportions of berried females in the resident populations of the various districts.

Observations on moulting and growth rate were continued at the Board's station at Nigg. Eighteen additional records of 'casting' were obtained, thus bringing the total number since 1931 up to 108. Males were found to 'cast' slightly earlier than females. Reference to these observations is made in the last paragraph of the Introduction.

7. BOTTOM FAUNA

France.

A study of the bottom fauna was carried out in the region of Utsire during a cruise on the trawler "Vierge de Boulogne" in April. An examination was also made of the stomach contents of the different species of fish caught in this area.

Scotland.

A paper on the examination of the stomach contents of haddock collected over a long period of years by the research vessel "Explorer" is in course of preparation.

A general knowledge of the food of plaice inhabiting the bays and estuaries has been obtained from a survey of stomach contents representative of all sizes of fish occurring within territorial waters. During the year quantitative sampling of the sea bottom was carried out with various types of dredges in an attempt to estimate the amount of food available in each bay so that the data could be correlated with the previous results from analyses of the stomach contents. Examination of this voluminous material is in progress.

SOUTHERN NORTH SEA

1935.

By

A. Bückmann.

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INTRODUCTION

The investigations in the area of the Southern North Sea were in general continued on the same lines as in the previous year.

One of these lines, the close study of the amount and distribution of the pelagic fry has been taken up again for thorough investigation. Conclusions from such investigations can, of course, be drawn after a certain time only, but some important individual results are already now available.

As far as the survey of the stocks of food fishes of our area is concerned each year of work means a step forward. We are thus constantly enlarging and extending our knowledge of the influence of the fishery upon the stock, its "fishery condition". It is well worth mentioning that there is a general consensus of opinion — based upon quite different methods and upon the study of various stocks of fishes — in concluding that returns and efforts in the fishery, as it is at present carried out in our area, are unfavourably related to each other. It will be part of our work to prove this theory and to submit our conclusions to practical fishery quarters as well as to the legislative authorities in order that practical issues may be devised.

With regard to the **herring**, the most important food fish of our area, other problems are more important. In addition to the fluctuations, the migrations and the shoaling concentrations have a decisive influence upon the returns of the fishery and they are consequently the objects of close investigations. As a means of tracing the migrations and of distinguishing the various individual herring-stocks occurring in the same area, the investigations into the morphological characters of the herring have played an important part ever since the Heincke period. The observations of the last decade, however, have shaken certain theoretical foundations of this method. These conditions were the subject of the meeting of herring experts at Lowestoft, on October 16th and 17th, 1935. The results of their discussions (see this volume, p. 7) will be of great importance to the work in our area.

A part only of the work carried out in the Southern North Sea area has been mentioned above. The importance of the other investigations is not at all less, as for instance the ecological researches in the coastal zone and the general plankton and the hydrographic work. Some of these investigations are only shortly reviewed in the following report, even not mentioned at all, as they are fully dealt with in reports of the Hydrographic and the Plankton Committees.

Our sincere gratitude is hereby expressed to the various companies, captains and crews of fishery patrol vessels, fishing vessels and lightvessels who have again this year given our work their valuable support.

The work carried out by Belgium in the southernmost part of this Area is recorded in the Report of the Combined North Sea and Eastern Channel Committee.

A. WORK AT SEA

Denmark.

The "Dana" was working in the Southern North Sea from June 6th to 22nd, when after a collision in fog she foundered at a depth of 29 m. of water east of Tail End; all material collected, was lost save some material, journals etc. from the Horns Reef area. Owing to these circumstances the contributions on the part of Denmark have been very small in 1935.

Fishing experiments from the "Dana" with the 50 feet otter-trawl were carried out at 28 stations in the Horns Reef area on June 6th—12th, especially for investigating the stock of **plaice.**

From the "Biologen" fishing experiments with the "Eel-tog" were carried out at 7 stations in the Nissum Broad on May 12th—13th and on Sept. 25th at 6 stations.

In the beginning of September work was carried out from a motor boat in inshore waters at Esbjerg to investigate the distribution of 0-group of plaice.

England.

The "George Bligh" was in continuous commission throughout the year. Sixteen voyages in all were carried out. Two comprised trawling work including transplantation, two for hydrography alone, three for plaice eggs, while the remainder were for plankton, especially phytoplankton and hydrography in connection with the migrations and concentrations of the herring. The M. V. "Onaway" was also in commission throughout the year and as usual carried out sampling of herring and sprat shoals during the appropriate seasons. She also made many special plankton and hydrographical cruises, both independently and in close touch with the "George Bligh".

The work on **fish eggs** and **larvae** on the Varne lightvessel, started in 1932, was continued and supplemented by work on the Galloper and Sandettié lightvessels. During the year the new Vertical Log was installed on the latter two lightvessels and on Smith's Knoll. The work on the Sandettié lightvessel was again made possible by the co-operation of Prof. Le Gall. The work at sea of the English naturalists and fish measurers, the routine current measurements and release of drift bottles from lightvessels, surface sampling on steamship routes etc. have been continued owing to the courtesy of Trinity House and the owners, masters, and officers of the vessels concerned.

France.

Les travaux de recherches dans le secteur sud de la Mer du Nord ont été poursuivis en France par le Laboratoire de l'Office Scientifique et Technique des Pêches Maritimes à Boulogne sur Mer, en collaboration avec la Station Navale de la Mer du Nord et de l'Islande, du Service des Ponts et des Chaussées Maritimes et de l'armement particulier.

Septembre-Octobre: Croisières des Avisos "Ailette" et "Quentin Roosevelt" sur les pêcheries de harengs du Sud de la Mer du Nord. Observations hydrologiques. Plancton. Novembre-Decembre: Croisières regulières des Avisos "Ailette" et "Quentin Roosevelt" en Manche Orientale et sur les pêcheries de harengs. Sections hydrologiques: Boulogne—Beachy Head; Boulogne—Folkestone; Dieppe—Dungeness; Antifer—Ste. Catherine. Pêches de plancton sur les pêcheries de harengs.

Observations permanentes à bord du bateau feu Sandettié. Observations météorologiques, pêches de plancton, prélèvements d'eau et températures: surface et fond.

Observations bimensuelles sur les routes des paquebots Boulogne—Folkestone (depuis le 1er Octobre 1935) et Dunkerque—Folkestone. Températures et prélèvement d'eau en surface.

Germany.

The S/S "Poseidon" was commissioned from January 4th to 25th in the area between Heligoland, the Silver Pit and the Eastern Channel (Beachy Head—St. Valéry en Caux) in which 15 sections in various directions were investigated. The purpose of this cruise was mainly the study of distribution and abundance of **herring larvae** and other **fish fry**, in connection with investigations into plankton and hydrographic conditions (e. g. nutrient salts) as well as investigating the sole and the bottom fauna.

The work from this cruise was supplemented on the cruise of the S/S "Poseidon", March 7th to 13th, in the German Bight where work of similar kind was carried out.

The "Biologische Anstalt" during the cruises of the fishery patrol vessel "Elbe" to the herring grounds of the Dogger Bank and to Smith's Knoll, September 30th to November 3rd, and of the patrol vessel "Weser", November 11th to December 11th, to the Flemish Bight and the Eastern Channel, had occasion to carry out investigations into the herring larvae and other fry, plankton and hydrography.

The M. S. "Augusta" of the "Biologische Anstalt" was commissioned, as and when required, throughout the whole year, for work in the inner German Bight. Specially, investigations into food fishes were carried out, during May and June, along five sections between Norderney and List (Isle of Sylt), and during July and September, near Heligoland.

Further, during the cruise of the "Elbe", from October 12th to 25th, the "Fischereibiologische Abteilung in Hamburg" had an opportunity of investigating drift-net caught herring.

Scotland.

The Scottish research vessel entered the northern sector during May month and investigated the area as far as the northern edge of the Dogger Bank. In August a comprehensive cruise was undertaken as far as the Danish coast. Observations were carried out during the latter month in the area between Ling Bank and the Jutland coast, while on the return

journey stations were worked between Esbjerg, the Dogger Bank and the Firth of Forth. On each of these cruises, trawling, hydrographic and planktonic observations were carried out concurrently.

B. FISH

I. General.

1. Statistics and Ichthyometrics.

England.

The collection has been continued in England and the number of the chief species measured are approximately as follows: — (The haddock have been handed to Scotland for analysis.)

At Sea

Plaice	Haddock	Cod	Turbot	Whiting	Hake	Total
1,306	42,207	13,312	49	4,781	19	61,674

On the Markets

Plaice	Haddock	Cod	Herring	Total
59,515	4,838	32,824	94,201	191,378

Germany.

The collection of statistical information, which was commenced last year by the fishery research station at Wesermünde and which bears upon the exact fishing place and the number of fishing days, was continued, and extended to include also the markets of Cuxhaven and Altona-Hamburg, in other words the catches of the entire German fleet of steam-trawlers. Detailed statistical information from high sea cutters was collected at Hamburg.

2. Methods.

England.

A new photometer has been designed and made in the Lowestoft Laboratory which uses a photo-electric cell and gives results precise to 1 mg. of P_2O_5. This has been found convenient and practical for use at sea in ordinary bad weather, and needs no practice nor personal colour sense. The first model was, however, not quite free from occasional lapses of accuracy and minor changes are being made for a full season's test. In the meanwhile some observations etc. were made during the year, as part of a long-period programme.

Germany.

The paper on pelagic fry etc. by the late W. Mielck and Cl. Künne, mentioned in last year's list of publications (No. 22) has been issued.

II. Cod and Haddock.

Denmark.

Market measurements of cod have been carried out at Esbjerg.

England.

Survey of stock of cod in the North Sea and landings has been continued by the observations of two measurers on the market at Grimsby and combination with statistics of quantity landed. The indications are that the survival rate has been reduced as compared with that normally established for the years 1921—1930.

Germany.

The material of **haddock scales** collected during recent years on German research cruises has been placed at the disposal of the Fishery Board Laboratory at Aberdeen for treatment.

Scotland.

The August cruise was specially devised for a survey of the haddock populations within the area. The main points for determination were the relative strength of the new recruitment to the **haddock** stock and the frequencies of occurrence of older fish on the southern grounds. Interpretation of the haddock catches will be found in the report of the Northern North Sea. The May cruise in the Middle North Sea area was extended to the northern profile of the Dogger Bank with a view to elucidating the main centre of distribution of the 1934 brood of haddock and to define the relative strength of its recruitment to the haddock stock.

All the other fish constituents of the trawl hauls were examined during the course of the routine operations. The data consist of length measurements, sex determination, collection of scales and otoliths for age determination, samples of stomachs for identification ashore of food contents.

III. Herring.

1. Survey of Stocks and Landings.

England.

Observations made on the landings of **herrings** during the current year have been confined to the North Shields and East Anglian fisheries, and data have been obtained to cover investigations into length, age maturity, vertebrae, weight and also the shoaling concentrations in the two above-mentioned fisheries.

At North Shields in May, June, and August a long series of samples was collected, the object being to obtain data relating to the change (if any) in the average number of vertebrae in the successive shoals which appear on the coast throughout the summer season. The fish were weighed in order to find out if any variation — rhythmical or otherwise — could be detected in the value K throughout the period, and at the same time scales were collected for the purpose of age and L1 determinations. Altogether, during this period 1,650 fish were examined.

At Lowestoft and Yarmouth during the autumn fishery the usual intensive examination of the shoals was continued, and here 3,100 fish were examined for age, length etc., and on the two markets 81,680

herrings were measured for the purpose of estimating the proportions of the ages in the landings. It should be mentioned that this year we have altered our statistical methods of estimating the proportions of the ages in the stock of fish on the grounds. The actual weight of each age-group landed has been obtained, so that it is now possible to make use of the total landings (in cwt.) in working out the proportions of the various age-groups throughout the season.

A forecast was again published in August. This was based on last year's statistical treatment of the data, together with the knowledge of the fluctuations of the fishery with the date of the full moons throughout the season, and once again this forecast proved to be accurate.

The predominant age-groups throughout the autumn season were the three's, six's and eight's.

France.

L'étude de la population des **harengs** de la Manche Orientale et du Sud de la Mer du Nord était continuée. Les résultats obtenus pour la saison d'hiver 1935—36 sont les suivants:

Taille

Longueur en centimètres...		19	20	21	22	23	24	25	26	27	28	29
Groupe Sandettié—Dyck.....	%	0.1	0.6	8.9	12.0	14.0	15.5	18.5	17.0	10.2	2.3	0.3
Nord Somme, Gr. I	%	—	0.5	4.0	12.0	23.8	21.9	17.8	14.8	4.6	0.5	—
Sud Somme, Gr. II	%	—	0.2	0.2	9.2	18.2	16.9	21.4	22.9	9.8	1.2	—

Age

Ans...		3	4	5	6	7	8	9	10	Plus
Classes		1932	1931	1930	1929	1928	1927	1926	1925	Avant
Moyenne générale des trois groupes	%	24.6	28.1	5.1	29.2	6.1	4.3	1.6	0.7	0.3

Trois classes de recrutement sont manifestement bonnes dans ces concentrations: Les classes 1929 et 1931 dont nous avions déjà signalé l'importance et la classe 1932 qui, dès sa première apparition dans les concentrations de ponte, se montre extraordinairement bien représentée. La classe 1930 se montre encore franchement déficitaire.

Germany.

The **herring** investigations by the "Fischereibiologische Abteilung in Hamburg", partly extending to the Southern North Sea area, are reported upon in the Administrative Report of the Northern North Sea Committee.

Holland.

During the herring season some 3000 **herrings** from the waters of Smith's Knoll, Sandettié and Dieppe were investigated as to age. The age-groups 5 and 6 (year-classes 1931 and 1929) were predominant. Further information has been given in the report of the Combined North Sea and English Channel Committee.

2. Rate of Growth.

England.

As stated above (III, 1), 1,650 fish were examined during the summer season for growth, but the data have not yet been worked up.

3. Net Experiments.

England.

Actual experiments with nets of varying meshes have not been carried out this year, but, continuing our policy of keeping in touch with changes in the size of commercial drift-nets, we have measured the meshes of 1,376 nets used in the autumn fishery. Over 60 % of these nets had 36 and 37 rows per yard. At North Shields, about 700 nets were measured, and here the average size of meshes is much smaller than at Lowestoft and Yarmouth.

4. Young Herring.

England.

Several hauls with the lance-seine were made on the north-east coast during the summer, and it was found that young herring were very plentiful. The size of the fish showed that they were derived from an autumn spawning.

France.

Les observations sur les jeunes harengs et les sprats pêchés dans la zone littorale étaient continuées.

Germany.

As in previous years observations on young herring collected during scientific catches in the German Bight were compiled. In May, 1935, young herring of 5—6 cm length, in June 7 cm., appeared in these catches; evidently they were autumn herring of the 1934 brood but being somewhat larger than usual they seem to originate from a comparatively early 1934 spawning.

5. Larval Herring.

England.

The usual observations have been made on the distribution of "spawny haddock", from which it is possible to locate spawning grounds.

The routine investigations on the Varne, Galloper and Sandettié lightvessels have been continued. The data indicate that striking differences in the influx of larvae into the North Sea may be found from year to year.

Germany.

The primary object of the "Poseidon" cruises in January and March, 1935, was the study of herring larvae. A valuable addition to the material was obtained from the January catches of the "George Bligh", the herring larvae of which were placed at the disposal of the "Biologische Anstalt Helgoland" by the Fisheries Laboratory of Lowestoft.

The number of larvae of the Dogger Bank autumn brood was rather small on the section Heligoland—Puzzle Hole—Silver Pit. The northernmost station showed the greatest catch. Several different groups of larvae were recognized within the Flemish Bight. Within the area of the East-Anglian coastal current larvae of different size were traced in small numbers the origin of which presumably should be sought in the Cromer Knoll area. In the eastern part of the Flemish Bight a group of larger larvae, 11—20 mm. — mean length 13 mm. — was observed, evidently belonging to the group found during November, 1934, in densities of 800—1000 individuals per m.^{2} between the southern end of the Deep Channel and the Noord Hinder L. V. They had chiefly been carried in an ENE. direction towards the Dutch coast, but were traced further north, although in smaller numbers, as far as the Haaks and the Terschelling Bank lightvessels. A second younger group of larvae, 10—11 mm., belonging to the Downs herring, was caught in moderate numbers to the west of the above-mentioned group in the middle Flemish Bight from the Dover Straits to about $52^1/_2{}^\circ$ N. Lat. Newly hatched larvae were found in smaller numbers near the Sandettié L. V. and slightly older ones, in densities of almost 2300 ind. per m.^{2}, near the banks of the French coast between Dieppe and Boulogne.

The presence of larvae from the Dogger Bank and the Flemish Bight areas was observed in March in the German Bight.

The study of the 1935 autumn spawning commenced during the October cruise of the "Elbe" and that of the "Weser" in November-December. The material from these cruises, although not yet fully treated, indicates that the number of larvae present on the western edge of the Dogger Bank was considerably greater in October 1935 (up to 2000 ind. per m.^{2}) than in October 1934. In the Cromer Knoll district large catches of larvae were not made, and larvae were also scarce near the Cleaver Bank in October-November. In the Noord Hinder district large quantities of Downs herring larvae were caught in December, one catch showing as much as 4600 ind. per m.^{2}; the distribution, however, did not reach as far west as in the two previous years. But few larvae were caught in the entrance to the Channel.

Experiments were again taken up on rearing spring herring larvae from the German Bight. For this purpose artificial fecundation was carried out with Ems herring. The larvae were hatched according to temperature in 12 to 16 days; after one week, however, a heavy mortality occurred and but few larvae reached the size by which the formation of the vertebral column is finished. Experiments based on the experience gained will be continued.

Scotland.

No herring larvae were secured during either of the cruises within the area in May or in August. This is the normal state of affairs at the times when and the places where observations took place. Sprat larvae, however, were encountered at rectangle K 9a off the Danish coast in August.

Herring spawning localities were determined from the occurrences of 'spawny' haddocks in the immediate neighbourhood of the Longstone at rectangle C 10 b and d during the second half of August and the first part of September.

6. Herring Races.

England.

Apart from the vertebral counts carried out at North Shields no work has been done on "Racial Investigations".

France.

Bien que les harengs du groupe II (Sud de la Somme) montrent cette année une moyenne vertébrale légèrement inférieure à 56.70 (56.681 ± 0.101) du fait de l'arrivée dans ces régions de harengs du Sud de la Mer du Nord à moyenne vertébrale inférieure ou voisine de 56.50, la stabilité du groupe reste évidente.

Le type Sud de la Mer du Nord a dominé encore sur les frayères du Dyck et du Sandettié et la moyenne vertébrale des harengs de cette région est restée pendant toute la saison de ponte voisine de 56.50 (56.517 ± 0.08). Entre l'embouchure de la Somme et le Cap Gris Nez (Groupe I), la moyenne vertébrale constatée, voisine encore de 56.50 (56.468 ± 0.11) montre une forte pénétration de harengs du type Mer du Nord en Manche.

Holland.

A great number of vertebral counts were made of larvae and young herring from the south-western bays of Holland, those of larvae being made from the beginning of May and the end of June, the young herring ones from the winter months. The Downs herring predominated altogether among the fry, in most cases also among the young herring.

Scotland.

The following is a short report by Dr. Wood on the examination of two samples of herring from the East-Anglian fishing.

Race analyses were made of two samples of Downs herring obtained through the courtesy of the Ministry of Agriculture and Fisheries, from catches landed at Lowestoft.

The first sample caught on October 23rd was representative of the early shoals of small maturing herring, the majority of which were three and four years old. The second sample caught on November 13th consisted almost exclusively of large herring, the outstanding age-groups being 6 and 8 years old respectively. Both samples contained a few spent fish, which are omitted from the table of the counts of vertebrae and keeled scales K_2.

Lowestoft: October—November 1935.
Downs Herring, Maturity Stages III to VI.

Vertebrae

55	56	57	58	59	60	Mean	σ	No. of Fish
3.1	45.8	47.1	3.6	—	.4	56.53	.657	225
2.7	34.5	56.9	5.5	.4	—	56.66	.641	220

Keeled Scales K_2

13	14	15	16	17	18	Mean	σ	No. of Fish
1.3	24.1	47.4	23.2	3.6	.4	15.05	.838	225
3.2	26.8	50.4	17.3	2.3	—	14.89	.805	220

These two samples do not show the agreement in the number of vertebrae and keeled scales that one would expect to find in herring spawning at the same season and on the same grounds. The relatively high number of vertebrae and the high number of keeled scales indicate that both samples were obtained from a stock distinct from the autumn spawners of the North Sea. Amongst Northern North Sea herring increases in the number of vertebrae associated with decreases in the number of keeled scales arise from admixture of spring spawners. In this case it is probable, as Dr. Hodgson has suggested, that the lower number of vertebrae in the first sample is due to an admixture in the earlier shoals of autumn spawners from the Lincolnshire coast and Dogger Bank.

7. Food of Herring.

England.

Herring food investigations have been discontinued. The material in hand covers five years' collections from the Shields fishing area, and four years from the Gt. Fisher Bank, Viking Bank and Klondyke grounds. All the collections have been examined and will be reported on in due course.

IV. Plaice.

1. Survey of Stocks and Landings.

Denmark.

During June at the fishing experiments of the "Dana" the rich year-class 1928 formed 4 % of the stock between 10 and 30 m. depth, as compared with 20 % at the same time of the year 1934. The absolute number of plaice of this year-class had decreased to $^1/_8$ of the number in 1934. The age-groups IV—VI (1935 constituted essentially of the poor year-classes 1930—31) amounted to 9 % only of the stock between the 10 and 30 m.-lines, and their number caught per time unit was $^1/_7$ only of the number of the same age-groups in 1934.

The poor year-class 1932 as III-group formed only 10 % of the stock. As a consequence of the disappearance of the 1928 year-class and the poorness of the following year-classes the outlook for recruiting of the stock of commercial fish for the live-plaice fishery was bad in 1935 and the same is the case for 1936. In the depth zone 10—30 m., in June 1935, the number of plaice of more than 25 cm. was about one third of that in 1934; the number of plaice of 20—24 cm. length had decreased to about $^1/_4$ and the number of plaice of 15—19 cm. length (mainly recruiting the fishery during 1936) had decreased to one half.

As to the younger year-classes the number of these seems to have been rather satisfying and their frequency may be considered as about normal, but the judgment here is rather uncertain in that the fishing experiments, presumably on account of the rough weather, gave comparatively small catches in the 5—10 m. depth-zone where at this time of the year part of these age-groups are to be found. In the depth zone 10—30 m. the number of plaice of 10—14 cm. length found was a little larger than in the preceding year.

On the occasion of the transplantation of plaice from the North Sea to the Belt Sea and the Sound otoliths were examined from 624 plaice caught during April by the Danish seine off Skallingen and in Slugen. The length of these plaice were about 19—25 cm. and the percentages of the age-groups in the plaice transplanted were about the following:

Age-group....	II	III	IV	V	VI	VII
Year-class...	1933	1932	1931	1930	1929	1928
Percentage ..	0.4	17	26	30	18	8

In the Nissum Broad the fishing experiments with the "Eel-tog" during May and September gave the following average number of plaice per 30 minutes haul:

Age-group	0	I	II	III	IV
May 1935.....	0	26	88	10	1
Sept. 1935.....	76	132	61	14	0

Here the number of the I-group as compared with the number of the same age-group of previous years was rather small and at about the same size as that in 1930 and 1931. The year-class 1934 in the northern part of the west coast of Jutland thus seems to be of about the same strength as the year-classes 1929 and 1930 (but stronger than 1931 and 1932) and poorer than the 1933-class.

Measurements of different market categories in Esbjerg fish market have been continued in March, May, July, September and October 1935, about 3,000—3,500 specimens each month. The size composition of the landings from each single fishing ground has remained more or less the same as in the previous year, with a tendency to increase. The fishing grounds for live plaice have shifted towards deeper water.

The size of each of the market categories (except "Small") has decreased and it has been about 10 % below the size in 1933. Otoliths have been taken of some hundreds of plaice from the Horns Reef area.

Market measurements have been carried out from the "Marinbiologisk Laboratorium" as in previous years; they have been considered in conjunction with the material from the Horns Reef area collected by the Danish Commission for the Exploration of the Sea.

Collection of material of 0-group plaice in the coastal waters off Esbjerg, Fanø and the Ho Bay was carried out from September 2nd to 6th. JOHANSEN'S Young-Fish Trawl was used at 20 localities; the catching power of the implement used was however not perfect. In different localities at north-east Fanø and in Ho Bay rather high quantities were however taken, viz. up to about 200 specimens per 15 minutes haul; in these localities the "Dana" had moreover June 14th also taken rather high quantities, up to 150 specimens per 15 minutes haul. Per positive haul the catch was about 200 per hour in June, primo September about 160 per hour. For comparison it is worth while to mention that previously JOHANSEN in 1922, i. e., a very good brood year, had a haul of 1356 specimens per hour as the richest one, which is somewhat higher than the best in 1935, viz. 804 per hour. Considering that the implement used in 1935 was not perfect, it seems that the brood of the year is present in comparatively great quantities in the area in question.

England.

The collection of otoliths of each trade category of plaice was continued at Lowestoft and Grimsby. The following number of fish were measured, weighed and otolithed (see Table 1). Unfortunately the landings of plaice at Lowestoft of "Large", "Medium" and "Small Medium" were so small in April that the merchants were unable to provide samples of any of these categories. In fact of these three categories only one and a half Cwts were landed per 100 hours fishing during that month.

The 1935 material has been worked up with the exception of the December samples from Grimsby, and the percentage numbers of each age-group, shown in Table 2, may be compared with those for 1931 to 1934 given in the previous reports[1]).

The 1928 year-class which has been the main support of the fishery for the last four years has largely lost its importance and numerically the 1932 (III-group) year-class predominates.

A preliminary examination of the relative abundance of the year-classes now being taken in the fishing, shows that the stock surviving from the spawning of the winters of 1929 to 1931 were on the whole below average strength with the possible exception of the 1930 year-class in the Grimsby fishery. The 1931 year-class, now in the IV-group, is particularly scarce in the landings at both ports. The 1932 year-class (III-group) however appears to be rich. It is not possible at the present time to say how it compares with the previous exceptionally abundant year-classes of 1922 and 1928 as there is some indication that the growth has been more rapid; it may therefore have been present in greater numbers in the grounds fished by the English trawlers than the more slowly growing year-classes.

The year's fishing from Lowestoft has been exceptionally poor; the abundance of all categories with the exception of "Dead Small' has been below that of previous years and in consequence the number of hours trawled by Lowestoft vessels fell to a very low level.

A report will be published shortly on the financial consequences of the increasing shortage of plaice in the Southern North Sea.

Germany.

Investigations for surveying the stock of plaice in the German Bight were carried out onboard the M.S. "Augusta" on 5 sections between the List Deep and Norderney in May and June, and in the vicinity of Heligoland in July and October; age determinations were carried out on 13,000 plaice. The rich year-class 1928, now 7 years old, was of some importance only in the northern part of the area in spring (up to 11 %). The year-classes 1929, 1930 and 1931 were but poorly represented everywhere. The year-class 1932, being now the III-group, was represented by 13—23 % of the stock on the sections and is evidently also poor. The year-class 1933 (II-group) was best represented — in the spring by 23—50 %, in the summer and autumn by 45 % — and therefore may be presumed to be of normal strength. Also the year-class 1934, while still the I-group, was rather abundant outnumbering even the II-group in certain places and may be expected to be of normal strength.

The survey of the plaice landings by German cutters from the North Sea has been continued and age investigations were made on more than 33,000 individuals. The catches from the Southern North Sea were again somewhat inferior to those of the preceding year. The rich year-class 1928, now 7 years old, which could scarcely be expected to be present in considerable numbers on the young fish grounds, preferably fished by the German cutters, still constitutes by far the largest portion of this year's landings: 4.8 million individuals or 41 %. Second position is

[1]) See Rapp. et Proc.-Verb., LXXXV, 2e partie, 44, 1933; LXXXIX, 2e partie, 44, 1934; and XCIV, 2e partie, 36—37, 1935.

Table I.

Number of Plaice measured, weighed and otolithed.

1935	Lowestoft Dead Small	Small	Best Small	Small Medium	Best Medium	Slabs, Large and Best	Total
April	555	334	108	—	—	—	997
July	460	270	263	201	162	37	1,393
October	419	252	347	—	105	64	1,187
December	418	242	304	125	105	51	1,245
Total...	1,852	1,098	1,022	326	372	152	4,822

1935	Grimsby Chats	Small	Big Small	Middles	Best Medium	Large Best	Large	Total
March	521	453	439	326	186	135	92	2,152
June	482	528	514	335	185	151	99	2,294
September	558	394	405	301	160	114	87	2,019
December	373	423	404	308	162	112	78	1,860
Total...	1,934	1,798	1,762	1,270	693	512	356	8,325

Table II.

Percentage Number of Plaice landed in each Age-Group at Lowestoft and Grimsby in certain Months of 1934—1935.

Port	Date		Age-Group II	III	IV	V	VI	VII	VIII	IX	X	XI+
		Year of birth	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923—
Grimsby	Dec. 1934	Percentage	1.3	7.8	26.0	14.5	34.2	3.9	2.7	2.1	1.3	6.1
Lowestoft ...	Dec. 1934	—	1.9	9.0	29.4	21.4	29.2	2.2	1.4	2.4	0.6	2.5
Grimsby	Mar. 1935	—	1.7	6.1	16.3	21.7	44.6	3.6	1.4	1.5	0.8	2.2
		Year of birth	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924—
Lowestoft ...	April 1935	Percentage	Insufficient Data									
Grimsby	June 1935	—	4.5	33.0	15.7	15.3	8.4	18.2	1.4	0.8	0.7	1.9
Lowestoft ...	July 1935	—	1.2	19.4	19.5	25.1	15.0	18.2	0.5	0.1	0.2	0.8
Grimsby	Sept. 1935	—	5.1	42.9	16.3	15.9	5.5	9.0	1.7	0.9	0.8	1.9
Lowestoft ...	Oct. 1935	—	1.2	21.6	19.7	25.2	13.3	16.9	0.7	0.3	0.3	0.8
Lowestoft ...	Dec. 1935	—	4.3	30.3	15.6	17.9	7.3	14.0	2.8	1.8	2.0	3.9

held by the year-class 1929: about 3 million individuals, and third comes the year-class 1930: 2.2 million individuals, while fourth comes the year-class 1931: 1.1 million individuals. The total number of plaice of the year-class 1928 caught by German cutters since 1930 amounts to about 35 millions as compared to $7^1/_2$ millions only of the year-class 1929. The corresponding figures for the year-classes 1927 and 1926 are 16 and 14 millions respectively. — Taking into consideration the small amounts of the recruits of the year-classes 1932—1930 the prospects for 1936 seem rather poor.

A comparison of the stocks of plaice of the Flemish and the German Bights has been published (5), it is based on the investigations of 1931—1934, the Dutch material having been kindly placed at our disposal by Dr. TESCH. A report has further been issued on the plaice landings by German cutters in 1934 (9). Reports on the investigations of 1935 at sea and on the fish markets are in press.

Holland.

In 1935, the plaice investigations were restricted to market measurements at Ijmuiden.

2. Rate of Growth.

Denmark.

In the southern Horns Reef area, in June, the length of the III- and IV-group was practically the same as in 1934. The average length of the II-group in 1935 was 2—4 cm. less than in 1934, and the average length corresponds to the increase in the amount of small plaice originating from the years 1933 and 1934.

Germany.

The average length of the age-groups III to V were, with very few exceptions only, in all series investigated 0.7—2 cm. greater than in the preceding year. Even if this is due partly to the fact that some catches were

made at a later season than in 1934, it has been generally established that the quicker growth of the older age-groups is still being continued. On the other hand, the average lengths of the II-group were generally shorter than in 1934, and this may be assumed to be a result of the greater number of individuals of the youngest year-classes.

3/4. Marking and Transplantation Experiments.

Denmark.

The marking and transplantation experiments on the Dogger Bank planned for the year had to be postponed. Of the previous experiments carried out in 1932, 1933 and 1934 very few recoveries have been reported after August 1935.

England.

The working out of the results of the English plaice marking experiments of 1929—1932 is being continued. A considerable amount of marked fish from these experiments are still being received.

A reciprocal transplantation of mature plaice between Continental and Scottish coastal waters was jointly undertaken by the Ministry of Agriculture and Fisheries and the Fishery Board for Scotland. The Ministry of Agriculture and Fisheries carried out a transplantation from the Scottish East Coast to the Danish West Coast. The object was to ascertain whether transplanted fish took up the local spawning migration of the area into which they are transplanted. Only a few have so far been returned.

Scotland.

On behalf of the Fishery Board, an attempt was made during the August cruise of the research vessel to transplant plaice from the Danish coast to the Scottish east coast at the stage when maturity would be approaching for the current winter spawning. Considerable difficulty was experienced in securing a sufficient number of fish at the right stage of development so as to secure immediate results as to the behaviour of the transplanted fish. The few returns so far made show that the movement was normal against the prevailing currents and that the transplanted fish adopted the direction taken by the resident population. As the results are promising the experiment will be renewed on a larger scale.

5. Eggs and Larvae.

England.

Three plaice egg voyages have been carried out in the Southern Bight during the year. The results are being worked up. Two of these voyages belong to the winter programme of 1934—1935 and one to the winter programme of 1935—1936 which is not yet complete. The routine larval investigations on lightships are being continued. (See B. III. 5).

Germany.

Plaice eggs and larvae from vertical hauls from the "Poseidon" and "Weser"-cruises have been sent to the Fisheries Laboratory in Lowestoft for further investigation.

V. Common Sole.

Denmark.

Material for determining the age of sole caught by the "Dana" has been collected but has not yet been worked up.

Germany.

The cruises of the "Poseidon" in January and March, 1935, were used to study the distribution of the stock of sole in winter. Even though incomplete, the material seems to indicate that the sole lived within the 40 m. line chiefly, the greatest density being between 35 and 40 m. In the deep pits examined (Silver Pit, Markhams Hole, Tea kettle Hole) comparatively few individuals were caught, a fact which presumably was due to the high water temperature of the winter 1935.

In the total material the year-class 1933 (as I-group first, later as II-group) proved to be best represented. The length distribution of the age-groups in spring, summer, and autumn did not show any deviations worth mentioning from earlier figures; the average figures for the winter, however, seem to be lower than BÜCKMANN believed them to be in a recent paper (Ber. d. Deutsch. wiss. Komm., N. F., Bd. VII, H. 2, 1934).

The working up of the material concerning sole fry collected on former cruises was commenced. A preliminary survey seems to confirm EHRENBAUM's assertion as to the main area of distribution of fry to exist in the eastern North Sea, off the east-Frisian isles. The greatest amount as yet found in recent investigations is 32 eggs and 6 larvae per 1 m.^{2} of surface (June 1930). The sporadic occurrence of eggs was ascertained as far north as coastal waters off Hanstholm (June, 1930).

VI. Other Fish.

Denmark.

Material for determining the age of **dab** caught by "Dana" in the Horns Reef Area has been collected but has not yet been worked up. All material of species other than those mentioned above (II and IV) has been measured and registered.

Racial investigations on plaice and dab from the Horns Reef Area have been carried out.

England.

Sprat. The year 1935 includes the last half of the 1934—1935 fishing season. Collection of fresh material has since been suspended, to allow time for the more thorough working out of the data collected during the six seasons beginning 1929—1930.

As in previous seasons observations were made on length, age, sex, maturity, fat-content, and food of the sprat.

Age-groups I, II, III were the principal components of the samples on the East Coast in 1934—1935 as in past seasons, for only in 1933—1934 has the IV-group been of any importance. In the drift-net samples I-group fish, although fewer than II-group fish, formed a higher proportion of the catch than they have done in any season since 1931—1932; the age compositions in 1931—1932 and 1934—1935 were, in fact, very similar. In the combined drift-net and tow-net samples the I-group fish were actually in a slight majority over the II-group. The III-group was relatively unimportant during the 1934—1935 season.

A sample of **whitebait sprats** was obtained from the Thames during each month from November, 1934 to July, 1935. Their length-frequency distributions showed only slight growth, but in the early summer they acquired a markedly unimodal distribution, accompanied by the elimination of secondary modes and a great reduction in numbers towards the upper limit of the size-range. This is in conformity with the results of past seasons.

Fat analyses carried out upon ten $^1/_2$ kg. samples of fish showed a fairly steady decline in percentage of fat from 17.5 % in late October, 1934 to 6.5 % in late February, 1935. This is in agreement with the results for 1932—1933 and 1933—1934, but there was no sudden decrease in fat in the new year as in 1932—1933.

The contents of 306 stomachs, from eleven samples of fish, were examined in 1934—1935. In the case of two samples most of the fish had been feeding very sparingly, chiefly on copepods, but in the other samples, as in previous seasons, recognizable food was extremely scarce or altogether absent.

France.

Mensurations étaient faites au cours des sorties en mer et au débarquement du poisson à Boulogne. Espèces étudiées: hareng, maquereau, merlan, cardine, lançons, sprats. Les contenus stomacaux des poissons étudiés étaient régulièrement examinés.

Sprats. Observations sur les pêcheries de sprats sur les côtes françaises de la Mer du Nord, de la Manche Orientale, de la Baie de Seine étaient faites comparativement avec les pêcheries de l'entrée occidentale de la Manche et de la Baie de Douarnenez. Les résultats de ces observations feront l'objet d'une publication spéciale.

Lançons. Observations sur le genre Ammodytes dans le Sud de la Mer du Nord, en Manche et sur les côtes françaises de l'Atlantique. Les résultats de ces observations seront publiés ultérieurement.

Germany.

A note has been published on the occurrence of *Syngnathus* (*Siphonostoma*) *typhle* on the east-Frisian coast (5).

As usual, observations have been collected on all other food fishes caught during the fishery investigations at sea. The working up of the material concerning **turbot** and **whiting** has been commenced.

C. SHELLFISH

England.

One paper is in the press (15).

Germany.

As in previous years rearing experiments with oysters were carried out with special assistance from the Ministries of Education and Alimentation. Good settling was successfully obtained, but in the rearing of the spat some difficulties were still encountered.

D. BENTHOS AND DEPOSITS

Denmark.

The Skalling Laboratory has continued the work mentioned in last year's report. The quantitative biological investigations 1931—35 of Ho Bay and other parts of the waddensea have been finished (Dr. H. Thamdrup). Every two weeks a regular survey of some hydrographic conditions in Ho Bay has been undertaken. Salinity, temperature, plankton by falling and rising tide. Plankton investigations in Ho Bay were made simultaneously, (Dr. H. Thamdrup). Biological investigations of the landfauna on shores (Ellinor Bro-Larsen). Botanical investigations in the waddensea and the marshland (Johs. Iversen).

Physiographical investigations in 1935: 1) The sedimentation in the marsh has been measured (Dr. Niels Nielsen). 2) General sediment-petrographical analysis of the bottom of the waddenarea (Noe-Nygaard, K. Milthers and Dr. Niels Nielsen).

Two volumes of "Meddelelser fra Skalling-Laboratoriet" have been published.

A certain co-operation in researches and methods has been established between the Skalling-Laboratorium and the Institutes at Büsum and Wilhelmshaven (Germany), den Helder (Netherlands) and Scolt Head Island (England).

Two papers on the disease of the eel grass have been published (1 and 11).

Germany.

During the January cruise of the "Poseidon" the bottom fauna of the Flemish Bight and the northern adjoining region was investigated with the Petersen grab. In the Eastern Channel and the Straits of Dover quantitative samples were not obtainable on account of the stony bottom. The flints were densely overgrown with hydroids, bryozoa, sponges, and *Balanus*, and in shallow water also with lithothamnia. The rich occurrence of *Ophiothrix fragilis* was remarkable. A complete sample from the Channel

contained 16 large mussels (*Glycimeris* and *Tapes*). In the southern part of the Flemish Bight the bottom consisted chiefly of loose sand mixed with small stones, but was sparsely populated only (*Ammodytes, Amphioxus, Syndosmya prismatica, Nephthys* and *Ophelia* occurred). The sandy grounds of the northern Hoofden showed a population similar to that of the area of the *Venus-gallina* community near Norderney and Borkum. In the northern part of the Channel Deep *Echinocyamus pusillus* and *Portunus pusillus* also were present. Towards the oyster ground the *Venus-gallina* community changed to the very dense *Echinocordium-filiformis* community. The rich occurrence of *Gebia deltaura* and *Callianassa subterranea* was here remarkable.

During the March cruise of the "Poseidon" detailed studies on the bottom population were made at 6 stations within the German Bight as in previous years.

The bottom fauna of the tidal zone in the Jade Bay was studied by an assistant of the "Biologische Anstalt" in Wilhelmshaven. This institution is in connection with the "Forschungsstelle Westküste" of Büsum, which carries out, among other work, biological research bearing on the practical problems of the reclaiming of land.

A paper has been published on observations regarding eel-grass in the north-Frisian waddensea (14).

E. PLANKTON

England.

The plankton investigations carried out by the Lowestoft Laboratory during 1935 were similar in scope to those of 1934. Nine cruises of the Research Steamer "George Bligh" and seven cruises of the Motor Drifter "Onaway" were devoted exclusively to plankton work on the following lines: (1) Investigation on the ether-soluble matter of dried plankton. (2) Investigation on plankton of northern grounds. (3) Investigations into the relation between abundance of plankton and hydrographical conditions. (4) The relation between phytoplankton concentrations and the autumn shoaling of herring.

Further reference to the plankton work will be found in the Administrative Report of the Plankton Committee. As a result of special interest to the fishery it may be cited here that, apart from a short period in the early part of the herring fishing season, the patches of *Rhizosolenia styliformis* and *Biddulphia sinensis* were never in positions were they could interfere with the shoaling of herring to any appreciable extent.

Germany.

During the cruise of the "Poseidon" from January 4th to 25th the distribution of makroplankton in the region Heligoland — southern edge of the Doggerbank—Hoofden — entrance of the Channel (as far as the line Beachy Head—St. Valéry en Caux) was investigated. The channel current which is characterized by the presence of *Turritopsis polycirrha* could be traced as far as the south-eastern edge of the oyster ground. In the southern part of the Hoofden it was forced strikingly close to the Dutch coast. Species of northerly character were found throughout the north-western part of the area under investigation; furthermore, *Nyctiphanes couchi* and *Parathemisto* as well as *Agalma elegans* were encountered in the south-western part, which considering the heavy water masses coming from the west indicates their westerly origin.

During the cruise of the Fishery Patrol Vessel "Weser" from November 11th to December 12th about the same region as in January was studied. The channel current (*Turritopsis*) could be followed as far as Borkumriff. Otherwise, no particular change was observed.

Current, though not very detailed, observations were made of the makroplankton in the vicinity of Heligoland. *Cyanea juv.* reaching a diameter of about 3 cm. occurred as early as February, very early in the year. Also *Aurelia juv.* was observed rather early — end of January, beginning af February — and of similar sizes. Perhaps these specimen are of a western origin (channel current?). In June extraordinary numbers of the turbellar *Alaurina composita* occurred.

A paper has been published on the occurrence of *Leptomysis mediterranea* in the German Bight (6).

Incidental to the Plankton Committee work frequency and determinability lists were prepared (makroplankton). The former deal exclusively with the area of the Southern North Sea.

During all the cruises in 1935 ("Poseidon", January: the Hoofden and the eastern part of the English Channel, March: German Bight; Fishery Patrol Vessels "Elbe" and "Weser", October/November and November/December: Doggerbank and Hoofden) the surface plankton was studied as closely as possible and in close relation to hydrography. The cruises specially of the "Poseidon" permitted the working out of the distribution of the several water masses and currents as well as their mixtures, the whole area under investigation having been covered with a close net-work of stations.

The publication of the results will take place along with those of similar investigations carried out in 1936.

Scotland.

At each of the stations on the May and August cruises, hauls were made with the following plankton nets — Standard, Hjort, 1-metre and 2-metre ring-nets — the larger ring-net being used horizontally as well as vertically. During May month, the plankton between the east Scottish coast and the Gut consisted mainly of *Calanus* in the older stages and little or no phytoplankton was observed in the collections. Within the area east of the Gut and north of the Dogger Bank phytoplankton increased in an easterly direction. In this area, also, older stages of *Calanus*

decreased but young stages increased. *Sagitta setosa*, *Oikopleura*, *Themisto* and *Aglantha* formed the greater part of the remainder of the catches. Small numbers of Euphausids, Decapod larvae and *Anomalocera* were taken at all depths in the neighbourhood of the Scottish coast.

In August, the hauls in the immediate vicinity of the Firth of Forth consisted chiefly of phytoplankton, *Acartia* and moderate numbers of Medusae. *Calanus* was practically absent from the collections in this area. Farther offshore, towards the Gut, *Calanus* and other Copepods predominated. East of the Gut, phytoplankton and *Sagitta* increased with an easterly tendency, while Copepods generally and *Calanus* in particular decreased. Towards the Skagerak, Copepods, except *Calanus*, were again common. In the region of the Great Fisher Bank, phytoplankton was present along with numerous *Anomalocera*, Decapod larvae, *Sagitta setosa* and some *Calanus*, *Themisto Limacina*, *Evadne* and *Aglantha*. Along the Danish coast, phytoplankton was not observed, but *Calanus*, *Sagitta setosa*, and *S. elegans*, *Aglantha*, *Tomopteris* and *Pleurobrachia* were fairly abundant.

F. HYDROGRAPHY

Germany.

The regular hydrographic observations from German lightvessels in the North Sea have been continued as usual; the last publication deals with the observations of 1934.

During the "Poseidon" cruise of January 1935 in the Hoofden, hydrographical series were taken at 12 stations in addition to numerous surface observations; all observations were taken by Dr. Zorell, Dr. Kalle, and Dr. Goedecke; the observations have sufficed to reconstruct the regional distribution of temperature and salinity as well as of further factors such as alkalinity, silicates, nitrites, phosphates, total phosphorus and diluted phosphorus. These series of observations were completed by the co-operation of the steamers "Portia", "Jessica" and "Hermia" who took hourly surface temperature observations and water samples for later determination of salinity on 12 voyages between Hamburg and London.

Holland.

The regular observations have been continued as before: Surface observations. Kon. Ned. Meteor. Instituut, De Bilt.

1) 4-hourly observations of surface temperature and daily observations of surface salinity. (Decade means, Bulletin Hydrographique).
Lightships: Noord-Hinder, Haaks and Terschellingerbank.

2) 4-hourly observations of surface temperature. (Decade means in Bulletin Hydrographique).
Lightship Maas.

3) Regular temperature and salinity observations at fixed stations on the steamship routes (Decade means in Bulletin Hydrographique.):
Vlissingen—Harwich,
Hoek van Holland—Gravesend,
Ijmuiden—Hull

The titrations have been carried out at the Rijksinstituut voor Chemisch, Microbiologisch en Hydrografisch Visscherijonderzoek, Den Helder, Director F. Liebert.

Norway.

The observations regarding surface temperature and salinity on the steamer routes Bergen—Newcastle and Bergen—Rotterdam have been carried out as in previous years, attention being drawn, however, to the fact that temperatures have been recorded by thermographs and 4 series of salinity determinations only have been made.

Scientific Papers concerning the Committee's Work published in 1935.

1) Blegvad, H., An Epidemic Disease of the Eel-Grass (*Zostera marina* L.). Rep. Dan. Biol. Stat., Vol. XXXIX. 1934.
2) Bückmann, A. und Kotthaus, A., Ein Vergleich der Schollenbevölkerung der Flämischen und der Deutschen Bucht auf Grund der holländischen und deutschen Untersuchungen von 1931—1934 bearbeitet. Rapp. et Proc.-Verb., Vol. XCIV, 3e pt. 1935.
3) Furnestin, J., La Cardine. Résumé des connaissances acquises sur la biologie de ce poisson. Rev. Trav. Office des Pêches Marit., T. VII, Fasc. 2. 1935.
4) Jensen, Aage J. C., On a great Change in the Size-Composition of the North Sea Plaice during the Latest Years. Rapp. et Proc.-Verb., Vol. XCIV, 3e pt. 1935.
5) Künne, Cl., Notiz über die Seenadel *Syngnathus typhle* L. Zool. Anz., Bd. 111. 1935.
6) — Über *Leptomysis mediterranea* G. O. Sars in der Deutschen Bucht der Nordsee. Zool. Anz., Bd. 111. 1935.
7) Lambert, L., La Culture de la Moule en Hollande. Rev. Trav. Office des Pêches Marit., T. VIII, Fasc. 1. 1935.
8) Le Gall, J., Statistiques biologiques et considérations sur les populations de harengs de la Manche orientale et du Sud de la Mer du Nord. Rev, Trav. Office des Pêches Marit., T. VIII, Fasc. 2. 1935.
9) Lundbeck, J., Die Schollenerträge der Deutschen Hochseekutter im Jahre 1934. "Der Fischmarkt", Jg. 3, Heft 4. 1935.
10) Mielck, W. und Künne, Cl., Fischbrut- und Plankton-Untersuchungen auf dem Reichsforschungsdampfer "Poseidon" in der Ostsee, Mai—Juni 1931. Wiss. Meeresunters. N. F., Abt. Helgoland Bd. 19. 1935.
11) Petersen, Henning E., Preliminary Report on the Disease of the Eel-Grass (*Zostera marina* L.). Rep. Dan. Biol. Stat., Vol. XL. 1935.
12) Thamdrup, H., Die marinbiologischen Untersuchungen des Skallinglaboratoriums in der Ho Bucht. Rapp. et Proc.-Verb. Vol. XCIV, 3e pt. 1935.

13) Savage, R. E., and Wimpenny, R. S., Phytoplankton and the Herring. Pt. II, 1933/1934. Min. Agric. and Fish., Fish. Invest., Ser. II (in the press).
14) Wohlenberg, E., Beobachtungen über das Seegras, *Zostera marina* L., und seine Erkrankung im nordfriesischen Wattenmeer. Nordelbingen, Bd. 11. 1935.
15) Wright, F. G., Report on the Maldon (Essex) Periwinkle Fishery. Min Agric. and Fish., Fish. Invest., Ser. II, Vol. XIV, No. 6. 1935.

TRANSITION AREA COMMITTEE

1935.

Dr. H. Blegvad.

Denmark.

Biology. (Dr. H. Blegvad).

The vessels used for the research work were: S/S "Biologen" (April—October) and a motor boat (July—August).

Plaice. Fishing experiments with the "Tog" were — as in former years — carried out throughout the Transition Area.

The rich year-class 1932 (III-group) was rather scarcely represented in the catches. In the northern Kattegat it had already, in most places, left the nursery grounds where now the I-group (year-class 1934) was strongly dominating.

In the Belt Sea the rich year-class 1932, too, was but poorly represented in the catches, due no doubt to the fact that throughout 1934, it formed the base of the plaice fishery in these waters. The II-group (year-class 1933) was below mean whereas the I-group (1934) in parts of the Kattegat and the Belt Sea was somewhat above mean.

Along the coasts fishing was carried out from a motor boat with Johansen's young plaice trawl in the summer months in order to investigate the strength of the 0-group and I-group of the plaice (see Figs. 1 and 2). The 0-group was considerably above normal in the northern Kattegat, the Sound and the northern Belt Sea and slightly above normal in the southern parts of the Transition Area. In the Baltic proper the 0-group was but poorly represented (see Baltic Area Report, Denmark).

The transplantations of undersized plaice from the North Sea to the inner Danish waters were continued, 134,200 kg. or about 1,219,000 ind. being transplanted to the Belt Sea, the southern Kattegat, the Sound and the western Baltic. In this year the transplantations in the western Baltic were extended to the waters south of Als according to an agreement with the leaders of the German transplantations in the adjacent waters. A comprehensive report of the scientific investigations in connection with the transplantations (for the years 1928—1933) has been published (1).

The transplantations of plaice to the inner parts of the Limfjord were continued, 155,090 kg. or 2,095,000 ind. being transplanted.

A quantity of about 25,000 kg. of undersized plaice from the west coast of Jutland was delivered to the Swedish Government and transplanted to the eastern Kattegat and the Sound.

Other Flatfish. Investigations as to the biology of other flatfish (esp. flounder and dab) were continued. Throughout the northern part the population of young dab was more dense than in former years.

Cod and other Gadidae. Ringtrawl fishing in spring showed that generally the stock of cod larvae was about normal; in the Western Baltic somewhat above normal. In the Limfjord the 0-group of the cod was met with in considerable numbers (during the preceding years none or only few individuals of the 0-group were caught in this water). Also the 0-group of the **whiting** was unusually rich in the Limfjord.

Herring. Investigations as to the extent of the spawning of the autumn herring were carried out as usual (Figs. 3 and 4). The amount of fry was — as has been the case in later years — somewhat below normal in the Belt Sea, the Sound, the western Baltic and the westernmost parts of the Baltic proper. Also the yield of the autumn fishery was below normal in these waters.

Sprat. Investigations have been carried out as to the effect of the sprat trawl fishery upon the youngs of other food fishes. It was observed that but few youngs of the plaice, the cod and other bottom fishes were caught by the sprat trawl, whereas sometimes considerable quantities of young herrings were caught by this gear.

Mackerel and **Eel.** Forecasts of the yield of the fishery were published in "Dansk Fiskeritidende" (by Aage J. C. Jensen).

Larvae of spring spawning Fishes. During April and May fishing experiments with the ring trawl were carried out. As mentioned the amount of cod larvae was normal or somewhat above normal. Some larvae of the long rough dab were found as far south as in the Western Baltic.

Norwegian Prawn and **Lobster.** Measurements of catches (scientific as well as commercial) have been made. A minimum size limit of 16 cm. from the rostrum to the end of the "tail-fan" has now been introduced for the Norwegian lobster.

The **Mitten-Crab** has made its appearance in a few new localities, but in single and grown-up specimens only.

Bottom Invertebrates. As in former years valuations of the bottom have been undertaken by means of PETERSEN's bottom sampler.

Plankton. Vertical hauls with net of fine gauze and with Hensen net have — as in former years — been made from various lightvessels in the Kattegat and the Belts. Vertical hauls with the Hensen net were carried out in connection with the ring trawl fishing.

Investigations into **Fish-Diseases,** and concerning the **Disease of Zostera marina** were continued. As to the Zostera-Disease a report was published by HENNING E. PETERSEN (2). The disease seems now to be retreating.

Publications.

(1) H. BLEGVAD: Transplantations of Plaice from the North Sea to the Belt Sea. 1928—1933. The Scientific Survey. Rep. Dan. Biol. Stat., No. XXXIX, 1934.

(2) HENNING E. PETERSEN: Preliminary Report on the Disease of the Eelgrass (*Zostera marina* L.). Rep. Dan. Biol. Stat., No. XXXIX, 1934.

Germany.

(Report from Dr. E. FISCHER, Deutscher Seefischerei-Verein).

Within the work on the effect upon the stock of the sprat and herring trawl fishery (see Baltic Area Report) extensive age analyses were carried out on **sprat** in W. Baltic, off Rügen and in the bay of Danzig. Morphological investigations were this year undertaken on a large sample of sprat from the bay of Danzig.

At the beginning of the year under report **transplantations of North Sea plaice** were done to improve the stock of plaice in the bays of Kiel and Lübeck. For the first time the transplantations were carried out with large means. The practical result was observed at the Kiel market as well as through marking experiments; whilst in the previous year 2700 marked plaice showed a return of 9.1 % recaptures in 9 months after liberation, the recaptures during a corresponding period were 20 % this year. Due to many objections as to the vitality of transplantation plaice in the Baltic having been raised, the transplantations were this year supervised under divers' control. The divers agree unanimously that the plaice behaved perfectly normally in Baltic waters and immediately on reaching the bottom they digged their way into the sand. Dead or faint plaice were not to be found near the place of liberation even after the expiration of some time.

The **market measurements of flat fishes,** i. e. plaice, flounder and dab, were continued as in previous years. The number of stations was limited to the principal landing ports, such as Kiel, Warnemünde, Sassnitz, and Kolberg, but here they were made very regularly every month. Eastwards, the district of investigation was extended and some samples from the East-Prussian coast were examined. The necessary base for treating age determinations of the several flat fish species was hereby obtained. The age and maturity of turbot also was investigated by means of market samples. During the close season the necessary material was provided by trial hauls from cutters.

An investigation commenced in 1933, into the spawning periodicity of the **Baltic shrimp,** *Leander adspersus*, was finished. The result attained was: as against other shrimps, such as *Crangon vulgaris* in the North Sea, the Baltic *Leander adspersus* is much less certain of maintaining the stock by natural propagation, particularly in the bay of Wismar. Here, the *Leander adspersus* spawns once a year only, and from mid-July to the end of August/beginning of September only at that, while a female North Sea *Crangon* may spawn several times. In addition, the number of abdominal eggs of the *Leander adspersus* is very much lower than that of the *Crangon vulgaris* in the North Sea; the following counts show this:—

cm	*Leander adspersus*	*Crangon vulgaris*
4	about 1000	about 1500
5	— 1300	— 3300
6	— 1800	— 6500

This comparative uncertainty as to upkeep of stock in connection with their short life and the fact that the conditions off the Baltic coast are very unfavourable for their existence, explains the disappearance, frequently for years, of this species. Their re-appearance, observed since 1923 may possibly be the result of a passive immigration of young stages from the northern Belt Sea and the Kattegat.

In connection with the *Leander* investigations and the eel investigations (yet to be mentioned), thorough **ecologic and economic-biological research work** was undertaken in the bay of Wismar. The collection of material has been finished and the treatment of the material has commenced.

To explain various problems of the **eel fishery** and the biology of the eel in coastal waters extensive investigations into the stock of eel of the bay of Wismar have been undertaken. The stock was subjected to examinations for size, age and sex composition, weight, fat content, food etc. For purposes of comparison of results, the examinations were divided into two neighbouring districts: Dassower Binnensee and Greifswalder Bodden.

In continuation of the "Deutsche Seefischerei-Verein"'s, for years continued liberation of **brown trout** in the Baltic, it was tried — for the first time

Fig. 1. Number of plaice of the 0-Group (year-class 1935) taken per fishing unit in the summer and autumn of 1935. The fishing unit used was a 30 minutes' haul with Johansen's young plaice trawl.

Fig. 2. Number of plaice of the I-Group (year-class 1934) taken per fishing unit in the summer and autumn of 1935. The fishing unit used was a 30 minutes' haul with Johansen's young plaice trawl.

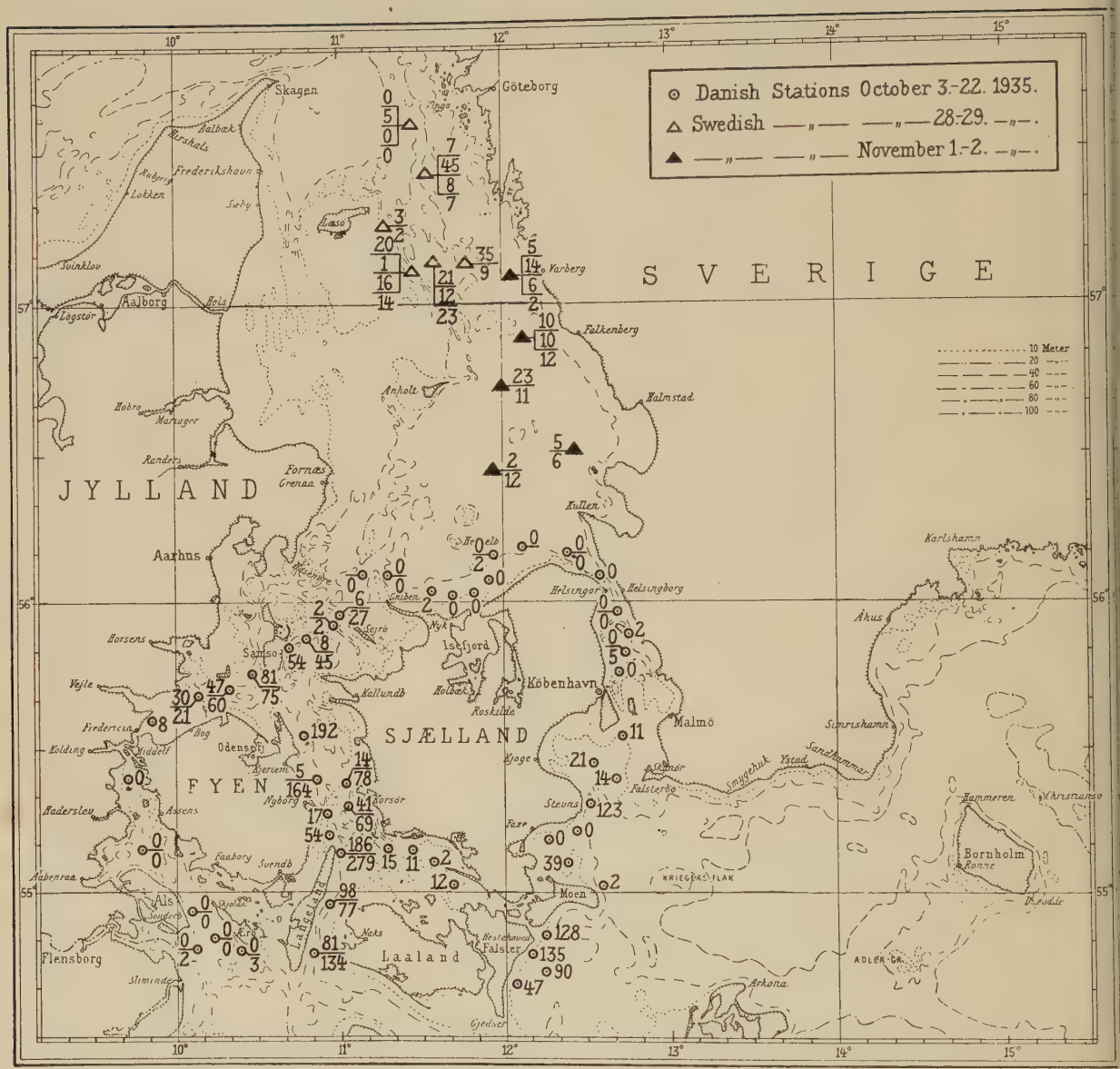


Fig. 3. Total number of herring larvae taken per 30 minutes' haul with a 2 metres stramin ring trawl in the autumn of 1935. — Where more than one figure is given at one station, the upper figure indicates catch in the upper layer (0—15 metres depth), the lower figure catch at the bottom, and figures between the lines catch in the intermediate water layers.

— in May, 1935, to liberate brown trout in water of higher salinity (10 to 19 ‰) in the bay of Wismar and the Salzhaff. A total of 700 2-year-old brown trout were marked and liberated. Although the growth of these seems to be somewhat less than of those liberated near Kolberg and Neukuhren, the recapture percentage is higher; from May to October, 1935, about 10 % of the marked brown trout had been recaptured. The average growth was 11.5 cm. — from 21.5 to 33 cm. — and the corresponding weight increment 300 to 400 gr.

Report by Dr. S. Strodtmann.

Im März/April 1935 wurde eine Untersuchungsfahrt mit dem Reichsforschungsdampfer "Poseidon" gemacht, die besonders der Untersuchung des Bornholmbeckens dienen sollte. Die Ausrüstung und einen grossen Teil der wissenschaftlichen Mitarbeiter stellte — wie auch bei früheren Fahrten — die Biologische Anstalt Helgoland und die Deutsche Seewarte Hamburg. Vom 15. III. bis 20. III. werden unter Leitung von Prof. Schulz die hydrographischen Verhältnisse des Bornholmbeckens und seiner Zugänge auf 44

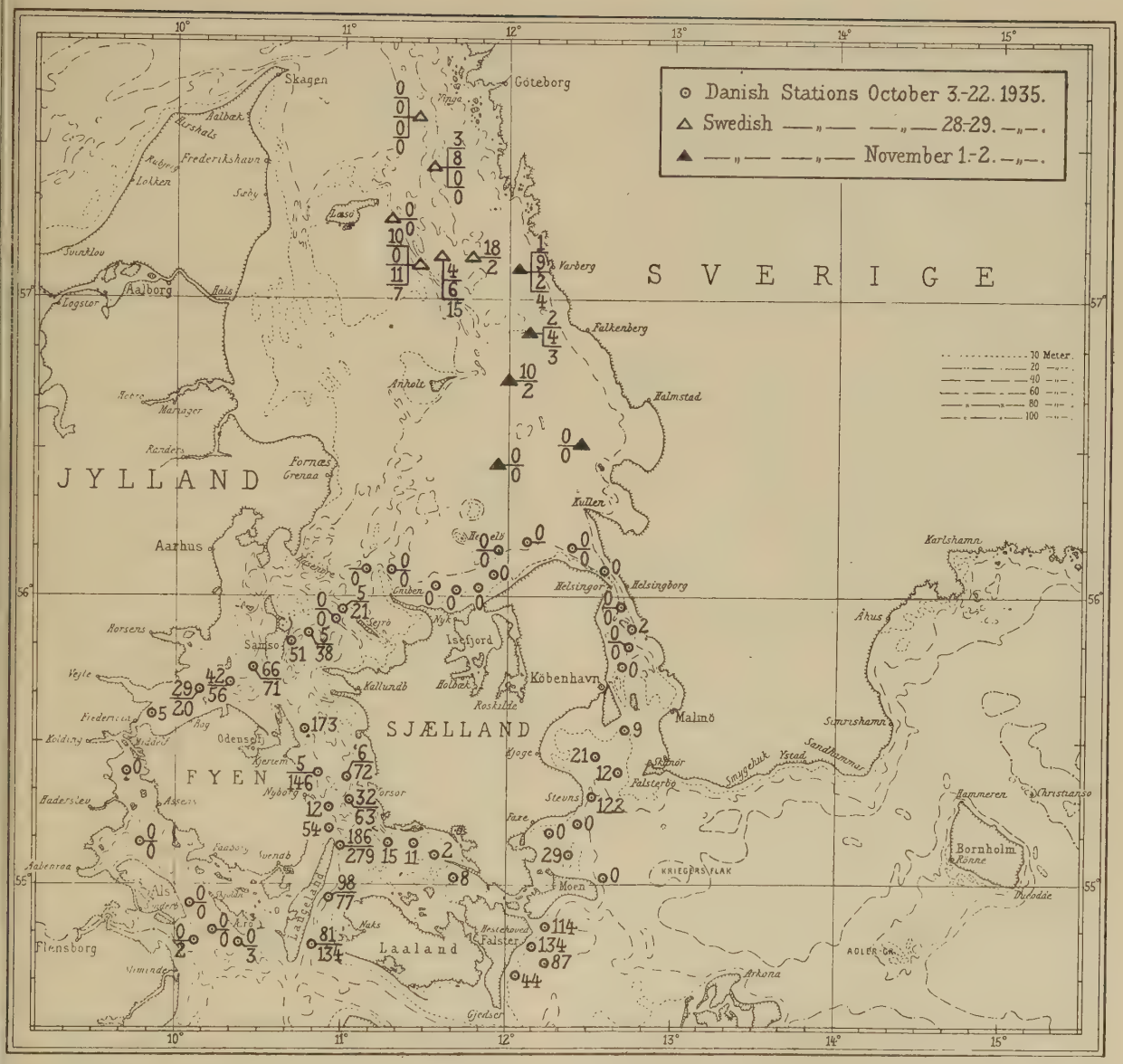


Fig. 4. Number of herring larvae of 5—9 mm. length taken per 30 minutes' haul with a 2 metres stramin ring trawl in the autumn of 1935. — For explanation of figures, see Fig. 3.

Stationen untersucht. Da die einzelnen Stationen so schnell wie möglich hintereinander erledigt werden müssen, ist für biologische Untersuchungen nur soweit Raum, als sie sich bei verankertem Schiff ausführen lassen. Wir mussten uns daher auf Vertikalfänge mit dem Eiernetz und auf Arbeiten mit dem Bodengreifer beschränken. Mit dem Studium der Eier beschäftigten sich Dr. KÄNDLER und Dr. KÜNNE, während die Bodengreiferfänge durch Prof. HAGMEIER untersucht werden.

Vom 21. III. bis zum 3. IV. wandten wir uns der Hauptsache nach fischereibiologischen Untersuchungen zu, und zwar wurde in erster Linie der **Flundernbestand** untersucht.

In dieser Jahreszeit findet man die laichreifen Tiere in der Regel erst von 60 m. Tiefe an. Unter dieser Tiefe vermindert sich die Zahl der Geschlechtsreifen sehr stark. Die wenigen Weibchen, die man bei 40—50 m. fängt, stehen noch vor der Laichreife, Stadium IV und V, d. h. sie sind auf der Wanderung zur Tiefe, oder sie haben schon ausgelaicht, d. h. sie sind aus der Tiefe zurückgekehrt. Die Zahl der letzteren war zunächst nur recht gering, sie steigt aber mit vorschreitender Jahreszeit.

Aber auch in 60—100 m. Tiefe sind die Flundern nicht gleichmässig verteilt. Von massgebendem Einfluss ist hier einerseits die Temperatur, andererseits die Tiefe. An den Stellen, wo eine Temperatur am Boden von 5.5° bis 6.5° herrschte, fanden sich mehr Tiere als bei 3.5° bis 5.5°, im letzteren Falle brachten einstündige Kurrenzüge nur 30—100 Tiere, während wir im ersteren Fall im Mittel über 250 erhielten.

Die Menge der in einer Kurrstunde gefischten Flundern war 1935 ungefähr die gleiche wie 1933, jedenfalls eher etwas niedriger als höher. Das dürfte aber darauf hinweisen, dass der Flundernbestand sich im ganzen etwas vermindert hat; denn bei gleicher Grösse müsste infolge der Schonung die Fangzahl höher als 1933 liegen.

Wir können die Abnahme der laichenden Flundern in der Nachkriegszeit stetig verfolgen. Die Menge beträgt jetzt nicht einmal den sechsten Teil der Vorkriegszeit, nachdem sie schon 1925 auf ein Drittel gesunken war. Bei weiterer starker Befischung der Laichgründe ist zu befürchten, dass die Flunder ein ähnliches Schicksal erlebt wie die Scholle.

Die **Schollen** wurden sowohl auf den Laichgebieten als auch auf den Flachgebieten der östlichen Ostsee in sehr geringer Anzahl gefangen. Ihre Menge wird von Untersuchung zu Untersuchung weniger. Auf den Fangplätzen, auf denen wir 1933 noch reichlich Tiere von 2 bis 4 Jahren erhielten, konnten wir kaum die genügende Zahl für unsere Aussetzungen erhalten. Auch die Oderbank mit ihrer Umgebung lieferte nur sehr spärliches Material. Es mag sein, dass die Jahreszeit noch reichlich früh war und dass die Tiere zum Teil noch eingegraben im Sande lagen. Vor allem aber ist die Ursache darin zu suchen, dass die Jahrgänge 1931 bis 1933 nicht gut ausgefallen waren, besonders 1933 war sehr schlecht. Infolgedessen gab es nur sehr wenige zweijährige Tiere.

Auch in diesem Jahre nahmen wir Verpflanzungen von Schollen vor, einen Teil der östlich von Rügen gefangenen Schollen setzten wir auf dem Adlergrund aus, um das Wachstum in den einheimischen Gewässern zu kontrollieren. Ein anderer Teil wurde in die Neustädter Bucht verpflanzt. Der Wiederfang der auf dem Adlergrund ausgesetzten Tiere war verhältnismässig gering (ca. 3 %). Das Wachstum war von Mitte Juli bis Ende August im Mittel 4 cm., das Maximum Ende August 6 cm. In der Neustädter Bucht wurden bis zum Herbst ca. 18 % wiedergefangen. Das Wachstum war im Juli im Mittel 3.2 cm., im August 5.8 cm., im Oktober 6.8 cm. Das Maximum betrug 11 cm. am 11. Oktober.

Besondere Aufmerksamkeit wandten wir ferner dem **Steinbutt** zu. Dieser Fisch gibt namentlich bezüglich seines Wachstums noch manche Rätsel auf. Man findet einerseits recht alte Tiere von geringer Grösse, andererseits aber auch solche von mehr als 40 cm. Länge. Um nun zu sehen, ob die Wachstumsverhältnisse sich bei anderer Umgebung ändern, nahmen wir eine Verpflanzung von kleinen Steinbutt der Oderbank in die Nordsee vor. Auf dem Steingrund bei Helgoland setzen wir 188 Steinbutt aus von einer mittleren Länge von 21.1 cm. Die Zahl der Wiederfänge ist bis jetzt noch recht gering, es wurden uns im ganzen 7 Stück abgeliefert, und zwar die meisten bald nach der Aussetzung. Bei einzelnen wurde eine Wachstum von 4—5 cm. festgestellt, doch lassen sich allgemeine Schlüsse aus dem bisher wiedererlangten Material noch nicht ziehen.

Report by Dr. R. Kändler.

Jungschollenuntersuchungen.

Um den Anschluss an dänische und schwedische Untersuchungen herzustellen, wurden von Kändler im Sommer 1935 an verschiedenen Plätzen der westlichen Ostsee Fänge mit dem Jungfischtrawl nach Johansen ausgeführt. Die Fangergebnisse an Schollen der 0- und I-Gruppe sind in den Karten S. 68 eingetragen. Sie sind recht gering, wurden doch in 37 Fangzügen mit einer Gesamtschleppdauer von 6 Std. nur 101 Schollen der 0-Gruppe und 19 der I-Gruppe gefangen. Verhältnismässig am häufigsten war die 0-Gruppe in der Eckernförder Bucht (im Mittel 18 Stück in 30 Minuten). Sehr spärlich war sie am Ausgang der Kieler Förde und in der Lübecker Bucht (3 Stück im Mittel); wieder etwas häufiger in der Wismarer Bucht (11 Stück). Künftig sollen noch weitere Fangplätze eingeschaltet werden, um genauere Durchschnittszahlen zu erhalten. Offensichtlich hat das Jahr 1935 der westlichen Ostsee nur einen ganz geringen Nachwuchs gebracht. Unter den gefangenen kleinen Fischen, die ihres Äusseren wegen zunächst als Schollen angesehen werden mussten, wurden durch Wirbelzählung 23 % Bastarde zwischen Scholle und Flunder festgestellt. (Im Gebiet Eckernförde—Kiel 18 %, im Abschnitt Travemünde—Wismar 32 %). Dieser hohe Anteil spricht nach unseren früheren Erfahrungen ebenfalls für einen schlechten Ausfall der diesjährigen Brutzeit. *Der ständige Mangel an Nachwuchs und die grosse Häufigkeit der Kreuzbefruchtung zwischen Scholle und Flunder kennzeichnen den anormalen Zustand der Schollenbevölkerung der westlichen Ostsee.*

Im pommerschen Küstengebiet führte Kändler Anfang September östlich von Sassnitz, in der Swinemünder Bucht und bei Kolberg Untersuchungen aus, und zwar wurde in der flachen Strandzone mit dem Johansentrawl und auf See bis zu 12—30 Seemeilen Entfernung von Land und 20—30 m. Tiefe mit der Garneelenkurre (Krabbentrawl) gearbeitet (vergl. Figur 5).

Wenn es auch gelang, mit dem Johansentrawl am Strande in ½ bis 2 m. Wassertiefe kleine Schollen der 0-Gruppe nachzuweisen, war ihre Zahl doch ausserordentlich gering: 8 bei Sassnitz, keine bei Swinemünde, 2 bei Kolberg. Von diesen 10 Exemplaren (36—60 mm.) erwiesen sich bei genauerer Untersuchung 3 als Scholle-Flunder-Bastarde. Die Zahl der zugleich gefangenen Flundern der 0-Gruppe betrug demgegenüber 378. Bei der Berechnung des Durchschnittsfanges von 30 Minuten ergeben sich für die

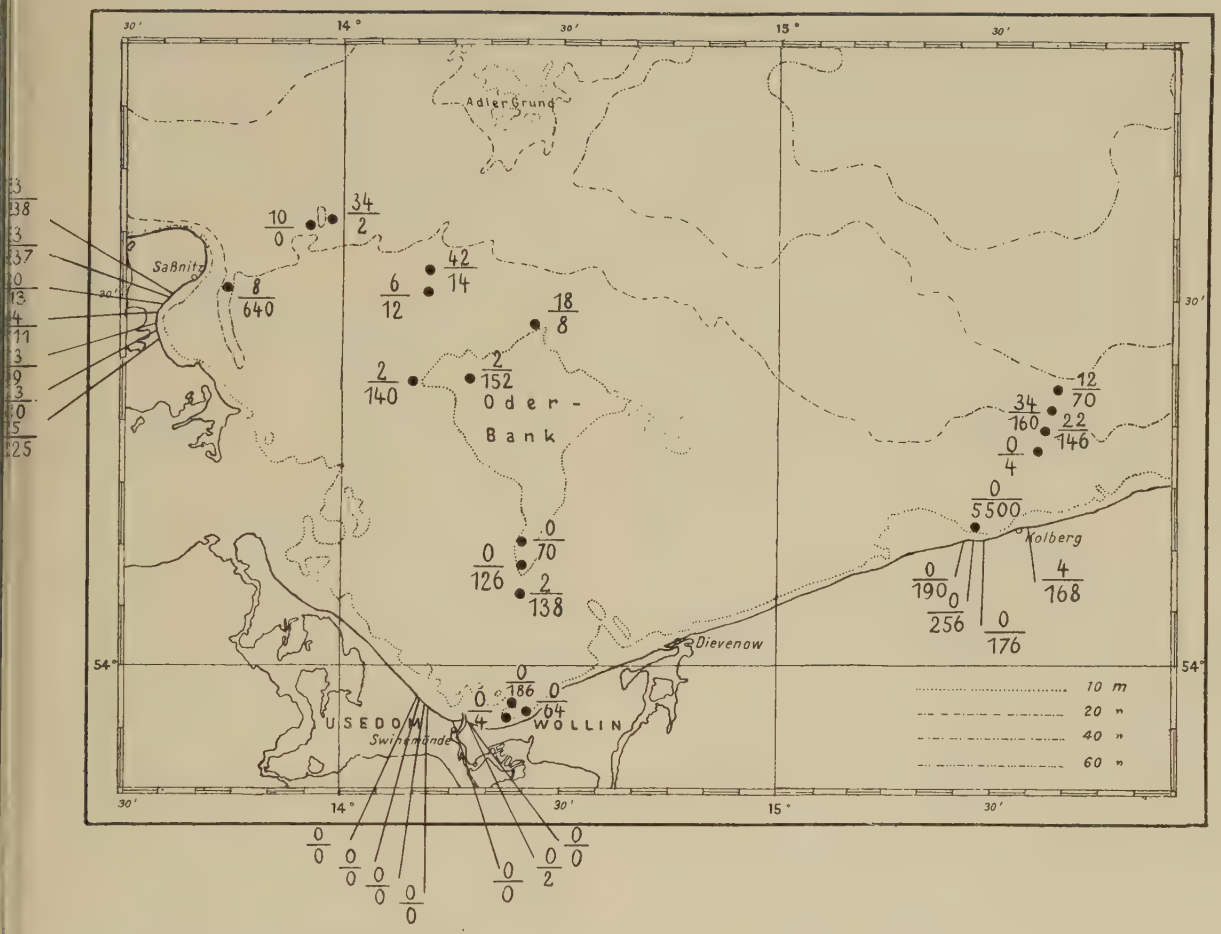


Fig. 5. Schollenfänge im pommerschen Küstengebiet, September 1935. ● Krabbentrawl ——— Johansens Jungfischtrawl. Anzahl in 30 Minuten, obere Zahl 0-Gruppe, untere Zahl I-Gruppe.

0-Gruppe der Scholle (einschl. Bastarde) folgende Zahlen: Prorer Wyk 3 Stück, Swinemünder Bucht 0, Kolberg weniger als 1. Danach müsste man den Erfolg der Brutzeit 1935 als sehr schlecht bezeichnen.

Die Fänge mit dem Krabbentrawl belehren uns jedoch eines besseren; denn sie brachten insgesamt 123 Schollen der 0-Gruppe. Setzen wir diejenigen Fänge ab, welche nur eine oder gar keine 0-Gruppe ergaben, so verbleiben 120 Stück in 9 Fängen, bei einem mittleren Fangertrag von 20 Stück in 30 Minuten. Diese Auswahl ist keineswegs willkürlich; denn sie umfasst alle Stationen, welche unweit der 20 m.-Linie vorwiegend in Tiefen von 17—30 m. liegen (vergl. Fig. 5). Die 5 Fänge auf dem westlichen und südlichen Teil der Oderbank lieferten nur 3 kleine Schollen, diejenigen in der Swinemünder Bucht und bei Kolberg gar keine. Die 0-Gruppe hielt sich also Anfang September fern von der Küste an den Abhängen zu den grossen Tiefen auf.

Nun können wir allerdings die Fangfähigkeit des Krabbentrawls (17 m. Grundtau) schwer mit der des Johansentrawls (4 m. Grundtau) vergleichen, aber es kommt hier auch gar nicht so sehr darauf an, die mit beiden Netzen erhaltenen Fangzahlen gegeneinander abzuwägen, als vielmehr sie zu der verschieden grossen Ausdehnung der beiden befischten Gebiete in Beziehung zu setzen. Die wenigen Schollen der 0-Gruppe, welche sich in der schmalen Strandzone aufhielten, fallen überhaupt nicht ins Gewicht gegenüber der Menge, die nach unseren Fängen zu urteilen das viele Seemeilen breite Gebiet von 17—30 m. Tiefe bevölkerte. Die Vorstellung, dass sich die 4—5 cm. grossen Schollen zuvor in der Strandzone aufgehalten hätten und von da bereits in das Tiefengebiet abgewandert seien, erscheint unwahrscheinlich, zumal da wir auch im August 1935 bei wiederholtem Fischen mit einem grösseren Krabbenhamen am Strande bei Kolberg in $^1/_2$—2 m. Wassertiefe unter einer grossen Anzahl kleiner Flundern nur einen Scholle-Flunder-Bastard, jedoch keine Scholle der 0-Gruppe erhielten.

Der Jahrgang 1935 bleibt zwar hinter dem des Vorjahres stark zurück (namentlich östlich von Sass-

nitz), ist aber aller Wahrscheinlichkeit nach häufiger als die ausgesprochen schlechten Jahrgänge 1931 und 1933 und gewiss auch besser als der nur östlich von Rügen zahlreiche Jahrgang 1932. Der Anteil der Scholle-Flunder-Bastarde war diesmal erheblich, 12 % gegen 3.6 % im Jahre 1934.

Der in der I-Gruppe stehende Jahrgang 1934 hat sich sehr gut entwickelt und wurde überall, zum Teil in recht bedeutender Anzahl, gefangen. Die Schollen hatten Längen von 6—17 cm.; die mittlere Länge war am grössten in der Swinemünder Bucht (14.1 cm.) und auf dem Südteil der Oderbank (13.7 cm.), etwas kleiner im Graben bei Sassnitz (12.6 cm.) und auf dem Nordteil der Oderbank (12.3 cm.). Die in unmittelbarer Nähe des Strandes in der Prorer Wyk gefangenen Schollen massen nur 9.4 cm. Eine ähnliche Grössenstaffelung wurde auch bei Kolberg festgestellt. Die Länge der I-Gruppe betrug hier am Strande 9.8 cm., weiter ab in 9 m. Tiefe 11.9 cm. Noch weiter vom Lande ab in 21—30 m. Tiefe nahm ihre Länge wiederum ab auf 9.3 cm. Diese Grössendifferenzen werden zum Teil wohl durch unterschiedliche Ernährungsverhältnisse, vor allem aber durch die Wanderungen der heranwachsenden kleinen Schollen bedingt sein, die nach unseren bisherigen Untersuchungen von tieferen Gebieten, wo die 0-Gruppe sich vorwiegend niederlässt, küstenwärts erfolgt.

In diesem Zusammenhang verdienen die Verhältnisse in der Swinemünder Bucht besondere Beachtung. Während der Poseidonfahrt wurden hier Ende März 1935 eine grössere Anzahl Schollen des Jahrganges 1934 mit der beachtlichen mittleren Grösse von 9.1 cm. gefangen. Zur selben Zeit waren an den Aussenhängen der Oderbank und nördlich von Kolberg noch viele kleine Schollen dieses Jahrganges von 4—5 cm. Länge vorhanden.

In die Swinemünder Bucht waren also nur die älteren und grösseren Exemplare gelangt, die Nachzügler aber noch nicht. Infolge der grossen Entfernung der 20 m.-Linie (35—40 Seemeilen) kann die Zuwanderung der kleinen Schollen nur allmählich und nicht so rasch erfolgen wie bei Sassnitz und Kolberg, wo Tiefen von 20 m. nur wenige Seemeilen von der Küste entfernt sind. Deshalb fanden wir hier die Strandzone dicht mit kleinen Schollen der I-Gruppe besiedelt. Für einen 30 Minuten-Fang mit dem Johansentrawl ergaben sich Zahlen bis zu 238 Stück bei Sassnitz und 256 Stück bei Kolberg. Im Gegensatz hierzu fingen wir bei Swinemünde am Strande nur ein einziges Exemplar der I-Gruppe.

Der reiche Fang mit dem Krabbentrawl bei Kolberg verdient eine besondere Erwähnung, da wir eine so gewaltige Zahl von kleinen Schollen (5,500 in 30 Min.) bisher noch niemals in dieser Gegend der Ostsee erbeutet haben. Noch ein Jahr zuvor fingen wir an dieser Stelle in derselben Zeit nur 40 kleine Schollen (meist II-Gruppe). Dieser plötzliche Wechsel innerhalb Jahresfrist ist ganz erstaunlich. Das Auftreten eines reichen Schollenjahrganges ist imstande, die Zusammensetzung der Plattfischbevölkerung grundlegend zu ändern und damit auch die Erträge der Fischerei nachhaltig zu beeinflussen. Einen ähnlichen Wechsel haben wir schon einmal etwa vor 10 Jahren beobachtet, als die reichen Jahrgänge 1923 und besonders 1925 die pommerschen Gewässer bevölkerten und einen starken Aufschwung der Schollenfischerei hervorriefen. Die Hoffnung ist berechtigt, dass auch in den folgenden Jahren die Schollenerträge, die im Jahre 1935 einen ungewöhnlichen Tiefstand erreicht haben, wieder ansteigen werden.

Flunder.

Die rassenkundlichen Untersuchungen an den Flundern der Ostsee sind abgeschlossen und werden demnächst veröffentlicht.

Sprott.

Altersuntersuchungen an Otolithen ergaben, dass in den Fischereifängen aus der westlichen Ostsee die I-Gruppe den Hauptteil stellt (65—80 %). Da die Sprottfischerei vorwiegend vom Spätherbst bis zum Frühjahr ausgeübt wird, sind dies Tiere, die einen zweiten Sommer hinter sich haben, also bereits zwei Wachstumsperioden vollendet haben. Ihre Geschlechtsorgane beginnen im Frühjahr zu reifen. Sprott der II-Gruppe traten mit 15—24 % auf, noch ältere mit 5—12 %. Im Frühjahr erlangen bereits die grössten Tiere der 0-Gruppe Marktfähigkeit, stellen aber in der Regel nur einen sehr geringen Anteil zum Fange. Mit Eintritt der Geschlechtsreife am Ende des 2. Lebensjahres wird das Wachstum stark eingeschränkt; für die einzelnen Altersstufen erhielten wir die folgenden Längenmittel: 0-Gr. 9.5 cm., I-Gr. 13 cm., II-Gr. 13.5 cm., IV-Gr. 14 cm. Die Weibchen wachsen etwas rascher als die Männchen und erreichen grössere Längen, der Unterschied in den Altersgruppen beträgt 0.6—0.8 cm. In der eigentlichen Ostsee (Küste Vorpommerns und Danziger Bucht) sind die Sprott in den Marktfängen durchschnittlich älter, hier stellen nicht Altersgruppe I, sondern II und III die Hauptanteile. Das Wachstum verläuft offensichtlich langsamer als im Westen.

Während der "Poseidon"-Fahrt im Mai—Juni 1931 wurde in den Tiefenbecken der Ostsee mit einem engmaschigen Schleppnetz mit Erfolg auf laichende Sprott gefischt. Die Schwärme bestanden zumeist aus 3 jährigen und älteren Tieren, 2 jährige waren in auffallend geringer Zahl vorhanden. Da aber öfters auch viele laichreife Männchen im Alter von 1 Jahr gefangen wurden, scheint der Mangel an II-Gruppe auf einen schlechten Ausfall des Brutjahres 1929 hinzudeuten.

Die "Poseidon"-Fänge bilden zusammen mit den Proben von Marktfängen ein gutes Material für Rassenuntersuchungen. Wirbelzählungen ergaben jedoch verhältnismässig geringe Unterschiede der Mittelwerte für die einzelnen Untersuchungsgebiete:

westliche Ostsee	Vert. S.	47.74	(611 Ind.)
Rügen-Gebiet.....	—	47.87	(378 —)
Bornholm-Becken.....	—	48.04	(383 —)
südl. Gotland-Mulde und Danziger Becken	—	47.76	(786 —)

Auffällig ist die Übereinstimmung der Wirbelzahl bei den Sprott aus der westlichen Ostsee und dem Danziger Gebiet. Dagegen haben die östlich von Bornholm angetroffenen Sprott eine um 0.3 höhere Wirbelzahl. Die bei Rügen gefangenen Tiere stehen zwischen beiden Gruppen. Zur Kennzeichnung morphologisch unterschiedlicher Formen sind diese geringen Unterschiede in den Mittelwerten kaum ausreichend; bestenfalls kann man den Bornholmer Sprott den übrigen Populationen als eine besondere Form gegenüberstellen. Auch die Zahl der Kielschuppen ist nur geringen Schwankungen unterworfen (11.3—11.5 im Mittel). Dagegen bestehen wohl hinsichtlich des Wachstums und des Altersaufbaues der Schwärme beträchtliche regionale Unterschiede. Es ist geplant, die Untersuchungen in dieser Richtung fortzuführen.

Plankton.

Seit Oktober 1934 werden auf dem Feuerschiff Fehmarn-Belt dreimal im Monat (am 1., 10. und 20.) zusammen mit Entnahme von Wasserproben Vertikalfänge mit dem Hensenschen Eiernetz ausgeführt. Die Auszählung der Fischeier ergab für die einzelnen Nutzfischarten die folgenden Hauptlaichzeiten und maximalen Eizahlen: Dorsch Febr. bis März, 114 Eier pro qm.; Flunder März bis April, 60 Eier pro qm.; Kliesche Juni, 38 Eier pro qm.; Sprott Ende Mai bis Juni, 83 Eier pro qm. Scholleneier wurden nur insgesamt 4 Stück gefunden, das erste am 20. Dezember, das letzte am 10. April. Allerdings konnten in der ersten Märzhälfte wegen des stürmischen Wetters keine Fänge vorgenommen werden, aber ein Vergleich mit den anderen Fischarten lässt keinen Zweifel an der ausserordentlich geringen Vermehrung der Scholle zu, was auch durch Untersuchungen der 0-Gruppe bestätigt wird.

Ammodytes. Die von D. S. Raitt (Journ. du Conseil Vol. IX) in den schottischen Gewässern entdeckte Ammodytes-Form, die er als neue Art (*A. marinus*) ansieht, wurde auch in der Ostsee gefunden (Kieler Bucht, östlich von Rügen und nördlich von Kolberg). Die Fangorte liegen entfernt von der Küste in etwa 20 m. Wassertiefe. Bei der Untersuchungsfahrt mit dem Dampfer "Poseidon" im März 1935 wurden in den Bodenwasserschichten des Bornholmbeckens mit dem Knüppelnetz eine grosse Anzahl von Ammodyteslarven und Jungfische von 1—6 cm. Länge gefangen. Durch Wirbelzählungen an den grösseren Exemplaren stellte Kändler fest, dass diese ohne Ausnahme der Form *marinus* zuzurechnen waren, der in den Tiefenbecken der Ostsee in den Wintermonaten offensichtlich in grosser Zahl laicht. Die Wirbelzahl variiert von 66—72 und beträgt im Mittel 68.5 (79 Individuen), während die Form *tobianus*, die im Juni im pommerschen Küstengebiet laichreif angetroffen wurde, 61—65 und im Mittel 63.1 Wirbel hat (51 Individuen). Auch die Strahlenzahl in den verschiedenen Flossen verhält sich ähnlich, wie es Raitt von dem schottischen Material angibt. Es ist jedoch bemerkenswert, dass die mittleren Wirbelzahlen beider Formen, wenn sie sich auch stets um wenigstens 5 Einheiten unterscheiden, nicht über das ganze Verbreitungsgebiet konstant sind.

An Ammodytes, die bei der Helgoländer Düne gefangen worden waren, wurde V. S. für *tobianus* zu 64.0 (158 Individuen) ermittelt, für *marinus* zu 69.9 (30 Individuen). Bei Island aus Kabeljaumägen gesammelte Ammodytes erwiesen sich sämtlich als *marinus* und ergaben die hohe mittlere Wirbelzahl 71.1 (30 Individuen), das sind nicht weniger als 2.6 Wirbel mehr als die gleiche Form in der inneren Ostsee besitzt. In Anbetracht dieser grossen Veränderlichkeit der Wirbelzahl kommt den verschiedenartigen Laichgewohnheiten der beiden Formen eine besondere Bedeutung zu. Im Dezember 1935 wurden bei Helgoland in 20 m. Tiefe einige laichende *A. marinus* gefangen, andererseits fanden sich im Mai im Beifang von Krabbenfischern aus Cuxhaven eine grössere Anzahl geschlechtsreifer *A. tobianus*.

Norway.

University of Oslo. (Johan T. Ruud).

The biological laboratory of the University has continued the investigations of **prawns.** Between June 17th—28th the M/C "Morild" made a cruise to the Svenør Bank in the outer Oslofjord. Trawlings were carried out with gears of varying mesh for the purpose of determining the influence of mesh-width on the catch. The investigations were made by Dr. Ruud and Mr. E. Sivertsen, M.A.

A new transplantation of small **plaice** from Danish to Norwegian waters has been planned for 1936, by cooperation between the Fisheries Directorate and the "Association for the furtherance of the Fishery of the Oslofjord within Dröbak".

Fisheries' Directorate. (P. Bjerkan).

Sprat. Analyses of commercial samples have been continued as in previous years. Sprats from the inner Oslofjord, usually smaller in size than immigrating young sprats, were this year so small and in such poor condition that they were of no commercial value before the month of July. Vertebral counts of samples of the year (1935) have been made as usual; some samples of very late spawned sprat show very low numbers of vertebrae.

The Flødevigen Hatchery. (Alf Dannevig).

Cod. 214.5 millions of cod fry were hatched and liberated in the fjords of the Skagerak coast.

Lobster. Lobster-rearing was accomplished between June 18th and August 26th. Owing to the scarcity of berried females, the number of fry handled was small only; the output was limited to 26,000 young lobsters of stages 3 and 4. They were liberated at three localities in southern Norway, and arrangements have been made to ascertain from the fishermen, if possible, the result of this liberation.

Oyster sprat. The rearing of oyster sprat has been continued. In the summer, 1934, the result was rather

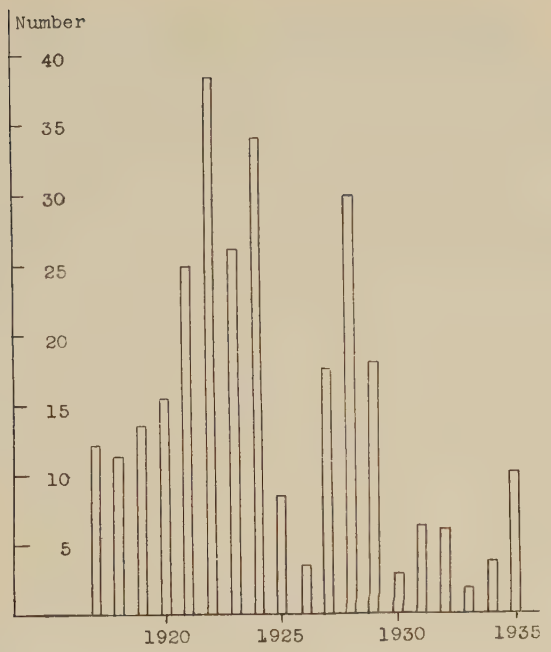


Fig. 6. Number of cod of the 0-group per haul in the littoral region of the Norwegian Skagerak coast.

poor as the young free-swimming larvae would not settle on the collectors, this year's result seems to be much better and in the autumn of 1935, the content of the basin was estimated at 2 to 400,000 young oysters, 2 to 5 cm. in diameter.

Hydrography, Plankton and Eggs.

During the cruises with our motorcutter "Ossian Sars" 139 hydrographical stations were taken mainly in the fjords and in the coastal waters. In the spring we made 198 hauls with the egg-net (1 m. in diameter) and 95 hauls with the young fish net of 2 m. diameter. These hauls were made to ascertain the occurrence of fish eggs and larvae. The material collected is not yet worked out.

Since 1903 we have made some hauls with a fine-meshed seine in the littoral region in order to ascertain the occurrence of the young cod fishes. From 1917 these hauls have been made quite uniformly. The results as to the cod are given in Fig. 6. During the last 10 years the number caught per haul has regularly been very low.

In order to keep in contact also with the occurrence of the older fishes, collection of material has been carried out in continuation of previous years' work. The catch of cod has been diminishing in the fjords, but has maintained a better level in the "skjærgård" (Flødevigen). The analysis of the age shows that practically only young fish are caught, 2 to 3 years of age.

The decreasing catches of cod per fishing unit inform us that the catches are decreasing in relation to the number of fishing gear used, and the inferior number of the 0-group makes it likely that the cause of the failure is to be sought in a smaller amount of cod fry during the later years. It may be that the amount of spawning has been less, or the survival of the fry has been poorer than in earlier years.

The measurement of lobsters has been continued. Some fishermen are allowed to keep all the lobsters caught without regard to the size-limit (21 cm.). The measurements show that most lobsters caught are of a size very near to the size-limit. The intensity of fishing is apparently very high. This is also confirmed by our marking experiments; out of 2566 lobsters marked and liberated 44 % have been recaught within a year. A paper on our lobster studies is now in print.

Publications.

Erling Sivertsen: "Torskens gytning med særlig henblikk på den årlige cyklus i generasjonsorganenes tilstand". Bergen 1935. Rep. on Norw. Fishery and Mar. Invest., Vol. IV, No. 10.

Sweden.

The new Swedish research vessel "Skagerak" was completed so late that the programme of biological investigations had to be somewhat altered; it could not possibly be carried through in its original form, and the work finally carried out may be summarized as follows:

Haddock.

Statistical data as to landings of haddock at the Gothenburg fishery port have been collected as before. Trawlings have been undertaken to investigate the strength of the 0-Gr.

Witch.

As regards witch, statistical material has been collected at the Gothenburg fishery port.

Plaice.

From the maps of the distribution of the 0- and I-Gr. of plaice along the west-coast and south-coast of Sweden, the occurrence of the 0-Gr. at the western coast was considerably less in 1935, than in previous years. The decrease is very marked, particularly in the Laholm Bay, where this group, however, was very much better represented than in the years 1929—32. Along the Scania-coast the 0-Gr. has almost disappeared, when excepting the eastern part of the south coast. The I-Gr., on the other hand, appeared absolutely and as compared to previous years very frequent in the coastal waters, evidently thanks to the rich year-class 1934.

Early in May transplantations of plaice were tried for the first time to Swedish waters, about 250,000 ind. were delivered partly from Esbjerg, partly from Thyborøn. Along the Halland coast and in the Sound

some 210,000 plaice and in Bohuslän Fjords some 10,000 ind. were liberated. 1500 ind. were marked. A comparatively small number of plaice have so far been recaptured. Valuable assistance was given by Dr. H. Blegvad and his assistants.

Sprat.

Efforts have been concentrated mainly on investigating the sprat. In addition to collecting material in accordance with previous years' programmes a more detailed examination of the quantitative frequency of zoo-plankton has been planned and started in the fjords of mid-Bohuslän and corresponding coastal waters in order to investigate possible connections between changes in the zoo-plankton and the migrations and growth of sprat. The area has been examined monthly as far as possible (see also Plankton report).

Extensive fishing experiments were carried out in spring for spawning sprat, particularly in the said fjords; the M/C "Clupea" belonging to the Laboratory was used.

Herring.

Between October 28th and November 2nd hauls were made with the 2 m. Ringtrawl for young herring at 11 Kattegat-stations. The results have been marked on the map, figures 3 and 4.

A number of herring samples from the Skagerak and the Kattegat have been analyzed as to race and age composition. Samples of young herring have been investigated in order to judge their geographical distribution.

Eggs and fry.

Due to the research vessel being commissioned so late no investigations were possible in spring and early summer. The samples of last year have been examined.

Pandalus.

The catch of *Pandalus borealis* in the Skagerak having decreased, trawls of different mesh widths have been tested to examine the possibilities of protecting the stock by using a greater mesh.

Hauls have been made from the R/S "Skagerak" as well as from commercial fishing boats; the experiments should be continued in order to provide more material.

Plankton.

An examination of the zoo- and phyto-plankton in Gullmar- and Uddevalla-fjords and off-shore waters was commenced in August 1935. Material was collected monthly through vertical hauls with the Hensen-net and the Nansen closing-net, at 8 stations.

During March and April complementing investigations were continued on the plankton-assimilation as related to submarine daylight.

In connection with submarine light penetration experiments also quantitative phyto-plankton samples have been collected and examined.

Publications.

Arvid R. Molander: Further Data concerning the witch. Svenska Hydr. Biol. Kommissionens Skrifter, N. S., Biologi, Bd. I, Nr. 6, 1935.

— Über das Vorkommen der jüngsten Altersgruppen der Scholle an der schwedischen West- und Südküste. Rapp. et Proc.-Verbaux, Vol. XCIV, 1935.

Orvar Nybelin: Über Eier und Larven der Rotzunge. Svenska Hydr. Biol. Kommissionens Skrifter, N. S., Biologi, Bd. I, Nr. 7, 1935.

H. Höglund and S. Landberg: Further Investigations upon the Photosynthesis of Phytoplankton by constant Illumination. Rapp. et Proc.-Verb., Vol. XCV. 1935.

Johansen's Young Plaice Trawl.

This gear has been used for a series of years in Denmark as well as other countries. It being of great importance that results of trawlings are comparable, the original measurements are repeated below:

Twine used for wings and square: 10 mm. 30/15
— — - batings: 7 mm. 30/15, cod-end 6 mm. 30/15

On haed rope 22 cork floats, height 4—4.5 cm., average diameter 5—5.5 cm.

On ground rope 26 sinkers of about 160 gm. each, total weight about 4.166 kg.

Wings: (Head rope and ground rope have 6 meshes on each staple)

head rope: 10 staples of 8.5 cm. each = 85 cm.;
ground rope: 10 — - 8.5 = 85 cm.
head rope: 16 — - 8 cm. each = 128 cm.;
ground rope: 16 — - 8 = 128 cm.
head rope: 9 — - 7 cm. each = 63 cm.;
ground rope: 16 — - 7 = 112 cm.

Bosom:

Head rope: 7 staples of 7 cm. each = 49 cm.;
ground rope: 7 — - 7 = 49 cm.

Total head rope: 210 meshes, 6 m. Total ground rope: 252 meshes, 7 m.

Total length of the trawl: 9 m. — 100 meshes deep.

Circumference of the bag: 400 meshes (4 × 100).

Measurements of the 3 divisions of the bag: cod end: 100 meshes of 6 mm.; batings and belly: 240 meshes of 7 mm., total length 5.5 m.; square: top part 102 meshes of 10 mm., bottom part 60 meshes of 10 mm.

Total length of the warp: 20 m., of the crow foot: 10 m.

Otter boards: 48 × 78 × 1.8 cm.

BALTIC AREA

1935.

K. A. Andersson.

According to the decision of the last meeting of the International Council for the Exploration of the Sea a special meeting of experts from the Baltic countries was held in Copenhagen on December 4th and 5th 1935, where the questions of further measures for protecting the stocks of flounder and salmon in the Baltic were closely deliberated.

The protocol from this meeting is submitted to the Bureau of the Council, (see page 29).

The work during the year under review was — as far as possible — carried out in accordance with the programme adopted and mainly devoted to the study of the herring, the sprat, the flounder, and the plaice. The most striking facts revealed seem to be that the 0-group of plaice during 1935 again was very poor and that the stock of the cod in the Bornholm region was exceptionally strong and gave catches larger than ever known. Remarkable also is the large and steadily increasing sprat fishery off the Polish coast.

The following are the reports of the work carried out in the area by the various countries represented on the Baltic Area Committee.

Denmark.

Biology. (Dr. H. Blegvad).

Investigations were carried out from the "Biologen" in the waters round Bornholm and at Rügen during the latter half of June. According to the early season (about a month earlier than in former years) the results of the coastal fishing for the 0-group of the various flat fishes are only to a certain degree comparable with those of former years.

Plaice. A very rich stock of the I-group of plaice was found at Bornholm as well as off Rügen, in good agreement with the rich 0-group of the previous year. In the waters off Rügen no specimens of the 0-group were found neither in shallow nor in deeper water. At Bornholm the 0-group was found in coastal waters but in numbers of any importance only on the west coast of the island (see Fig. 1). In deeper water no individuals of the 0-group were found.

Flounder. The 0-group of the flounder was not found off Rügen. Its occurrence at Bornholm appears from Fig. 1. In the Hammerhavn (the north-west point of Bornholm) the 0-group was very numerous, but elsewhere on the coast it was but scarce.

Turbot. No individuals of the 0-group of the turbot were encountered neither at Rügen nor off Bornholm.

Sprat. By fishing with ring-trawl east and west of

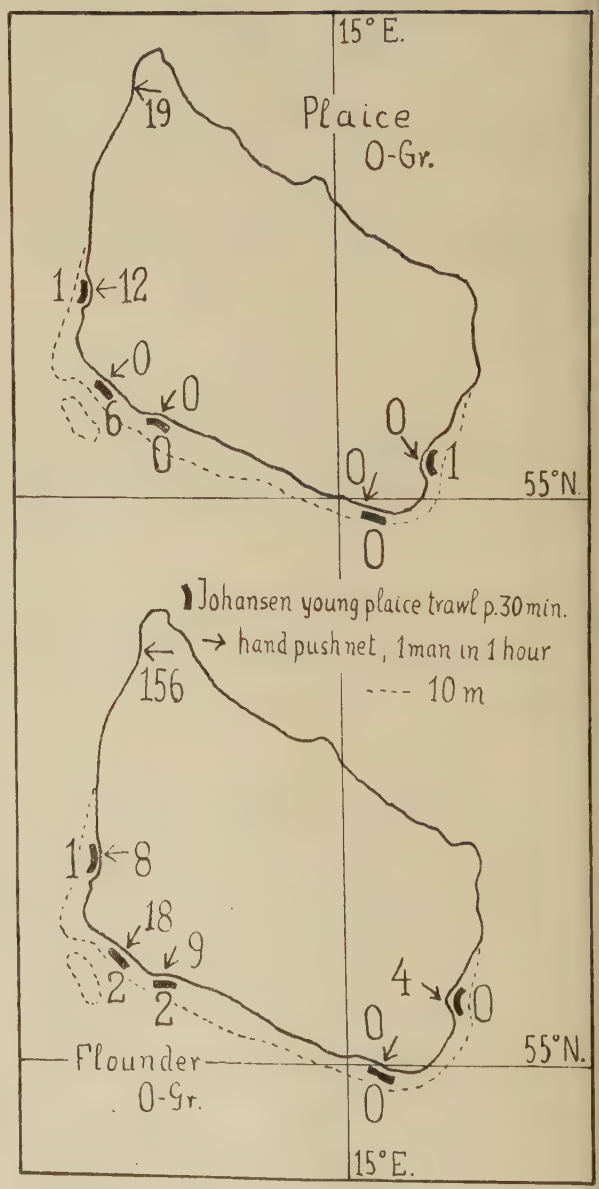


Fig. 1. Results of the fishing experiments in June, 1935 with Johansen's Young Plaice Trawl and the Hand Push Net in the coastal waters round Bornholm in order to ascertain the strength of the 0-group of Plaice and Flounder.

Bornholm considerable numbers of eggs and larvae of the sprat were caught.

Cod. The I-group of the cod was comparatively rich both at Rügen and off the coasts of Bornholm. In deeper water off Rügen fairly large numbers of the 0-group were caught.

Valutations of the sea bottom were carried out round Bornholm and in the waters east of Rügen.

The Food of the Herring. The investigations started in 1932 have been continued. A report by Dr. P. Jespersen is in preparation.

Hydrography.

Observations of temperature, salinity and oxygen contents were carried out from the "Biologen" at a few stations near Bornholm in June. The observations will be published in the Bulletin Hydrographique.

At Christiansö near Bornholm the Danish Meteorological Institute has made daily observations of the temperature and the salinity (by hydrometer) of the surface water. These observations will be published in the Nautical-Meteorological Annual of the Institute.

Finland.

Biology.

Material for scale-analysis of **salmon** has been collected as before (see the Salmon and Trout Committee). Statistics of the **seals** killed within the Gulf of Bothnia and Finland were collected.

Germany.

The following reports by Dr. E. Fischer and Professor Schulz may be briefly summarized as follows:

Age-analyses of herring have been carried out extensively in the Baltic. The influence of the fishery on the young fish stock of herring and sprat has been subject to special investigations, occasionally total catches were investigated as to composition of catch, size, age, weight, sex and maturity. Similar investigations will be continued in 1936.

The investigation of the flounder of the Jasmunder and Greifswalder Bodden and the Stralsund waters was finished and for completion of this work some 500 flounder of the Frisches Haff were marked and liberated near Passarge and Neukuhren.

Investigations have again confirmed that the Greifswald flounder is a specially tasteful and valuable fish, and experiments have been made to transplant specimens to other areas.

The report of Dr. Fischer also deals with investigations of other flounder stocks and other experimental transplantations.

Professor B. Schulz briefly summarizes the hydrographical work at 91 Baltic stations, regularly distributed over the Bornholm-Becken, and twice visited at short intervals.

Biology. (Dr. E. Fischer).

Die im Programm der Internationalen Meeresforschung vorgesehenen Altersuntersuchungen an **Heringen** wurden an Ostseeheringen im grösseren Masstabe durchgeführt. Dabei gelangte Material aus der westlichen Ostsee, Rügen und der Danziger Bucht zu Verarbeitung. Ergänzt wird dieses Material im Frühjahr durch Altersanalysen an den Schwärmen der Frühjahrslaichheringe der Schlei, Trave, Rügen und Ostpreussen.

In grösserem Umfange beschäftigten uns Untersuchungen über die Einwirkung der Herings- und Sprottzeesenfischerei mit zwei Booten auf den Bestand an Heringen und Sprott und auf jüngere Stadien anderer Nutzfische. Die Herings- und Sprottfischerei der hauptsächlichsten Fanggebiete der Ostsee (westliche Ostsee, Küste von Rügen und Danziger Bucht) wurde seit November 1935 unter ständiger Kontrolle gehalten. Ausser den Untersuchungen, die sich lediglich mit der technischen Seite der Fischerei befassten, wurden in Zeiträumen von gewöhnlich zwei bis drei Tagen die Totalfänge der Fischer sowohl auf Fangzusammensetzung, Grösse, Alter, Gewicht, Geschlecht und Geschlechtsreife untersucht. Die Untersuchungen werden auch im kommenden Jahr 1936 in dieser Weise fortgeführt werden.

Die Untersuchungen über die **Brackwasserflunder** im Grossen Jasmunder Bodden, im Greifswalder Bodden und im Stralsunder Strom wurden im Berichtsjahr zu einem gewissen Abschluss gebracht. Zur Ergänzung wurden die Untersuchungen auf die Brackwasserflunder des Frischen Haffes ausgedehnt.

Im Verlauf dieser Arbeiten wurden Anfang Oktober etwas über 300 Stück Flundern aus dem Frischen Haff markiert und im Haff bei Passarge eingesetzt. Ferner wurden morphologische Untersuchungen an Flundern des Frischen Haffs und zum Vergleich an der Flunder bei Neukuhren vorgenommen. Zur Feststellung der Wanderung der an der Küste von Ostpreussen vorkommenden Flundern wurden im Sommer 200 Flundern bei Neukuhren markiert und dort in Küstennähe ausgesetzt.

Die früheren Untersuchungen des Deutschen Seefischerei-Vereins an Flundern des Greifswalder Boddens haben ergeben und unsere Arbeiten aus neuester Zeit haben bestätigt, dass der Greifswalder Bodden ein gutes, nahrungsreiches Aufwachsgebiet für die Flunder darstellt. Die dort aufwachsende Flunder ist sehr fleischig und schmackhaft. Sie hat — wie Markierungsexperimente ergaben — ein durchschnittliches jährliches Wachstum von 6—7 cm. Von den dort markierten Flundern wurden innerhalb eines Jahres 16 % im Bodden wiedergefangen und 4 % ausserhalb des Boddens an der Ostküste von Rügen und an der hinterpommerschen Küste.

Da der Nahrungsreichtum im Greifswalder Bodden durch den dort vorhandenen Flunderbestand anscheinend ungenügend ausgenutzt wird, wurde im Dezember 1935 ein **Verpflanzungsversuch von jungen Ostseeflundern in den Bodden** vorgenommen. Insgesamt wurden über 500 Flundern im "Graben" bei Sassnitz,

einem bekannten Aufenthaltsplatz junger Plattfische, gefischt, von Sassnitz aus auf Lastwagen nach Lauterbach befördert und, nachdem sie markiert waren, an verschiedenen Stellen des Greifswalder Boddens ausgesetzt. Verpflanzt wurden in erster Linie die im Herbst in grossen Mengen an der Ostküste von Rügen sich aufhaltenden Flundern der Altersgruppe II. Zur Kontrolle wurden 200 Flundern von der gleichen Fangstelle und gleichen Beschaffenheit markiert und in der Ostsee wieder ausgesetzt.

Ein anderer Markierungsversuch an Brackwasserflundern wurde im Stralsunder Strom bei der Insel Ummanz vorgenommen. Davon wurden bisher insgesamt 28 % wiedergefangen, davon 13 % in den Rügenschen Gewässern und 15 % in der freien Ostsee (Oderbank, Ostküste von Rügen, schwedische und dänische Küste). Auffällig war, dass keine der in den beiden Gebieten, Greifswalder Bodden und Stralsunder Strom, markierten Flundern in dem benachbarten Brackwassergebiet wiedergefangen worden ist. Soweit die Flundern nicht im Aussetzungsgebiet geblieben sind, sind sie in die Ostsee gewandert. Das Wachstum der im Stralsunder Strom markierten Flundern betrug innerhalb von $^3/_4$ Jahren nur 2—3 cm.

Eine Verpflanzung von Ostseeflundern nach dem Grossen Jasmunder Bodden verfolgte kein praktisches sondern ein mehr theoretisches Ziel. Im Dezember 1935 wurden 150 Stück grössere Ostseeflundern der Altersgruppe IV—V markiert, in den Grossen Jasmunder Bodden gebracht und in dessen Südende in der Nähe von Lietzow ausgesetzt. Durch diesen Kontrollversuch wollten wir prüfen, ob sich die vor dem Laichen stehende Flunder der freien Ostsee bezüglich des Abwanderns anders verhält als die im Jasmunder Bodden indigene Flunder, die bekanntlich nicht auswandert und im Bodden laicht. Die bisher zurückgemeldeten, vor der Laichreife stehenden markierten Ostseeflundern scheinen im Gegensatz zu der Jasmunder Flunder tatsächlich abwandern zu wollen. Der grösste Teil der Wiederfänge wurde bereits jetzt aus dem nördlichen, dem Ausgang zur Ostsee naheliegenden Teil des Jasmunder Boddens, dem sogenannten Breeger Bodden gemeldet. Völlige Klarheit können erst die Wiederfänge aus den Frühjahrsmonaten bringen.

Weitere Untersuchungen galten einer in der Vierendehl-Rinne bei Stralsund im Dezember 1934 gefundenen Flunderform. Diese sich vor der Laichzeit immer dort aufhaltende grosse raschwüchsige Flunder ist sowohl an der Westküste von Hiddensee als auch an der Küste des Fischlandes und Mecklenburgs bis in die Lübecker Bucht Gegenstand der Stellnetzfischerei. Es ist — wie Markierungsexperimente zeigten — eine ausgesprochene Küstenform, die auch in unmittelbarer Nähe der Küste laicht. Nachdem im Winter 1934 bereits eine Markierung dieser Flunder vorgenommen wurde, ist im Dezember 1935 eine erneute Markierung von etwa 300 Tieren erfolgt. Ferner sind Untersuchungen über die Biologie und über die morphologischen Merkmale dieser Flunder eingeleitet.

Hydrographie. (Prof. Dr. B. Schulz).

Die im Frühjahr ausgeführte "Poseidon" Fahrt (14. III.—3. IV. 35) diente neben fischereibiologischen Arbeiten vor allem einer eingehenden Untersuchung des hydrographischen Zustandes des Bornholm-Beckens. Insgesamt wurden 91 ziemlich gleichmässig über das ganze Gebiet verteilte Serien gewonnen und manche Punkte in kurzem Zeitabstande zum zweiten Male besucht. Die Untersuchungen erstreckten sich ausser auf Temperatur und Salzgehalt auf Sauerstoff, Phosphat, Gesamtphosphor, gelösten Phosphor, Nitrit, Alkalinität, Wasserstoffionenkonzentration, Farbe und Sichttiefe. Die hydrographischen Arbeiten wurden ausgeführt von Prof. Schulz, Dr. Kalle, Dr. Goedecke, R. Hatje, O. Hatje.

Latvia.

Statistics.

The Board of Fisheries and Pisciculture (Ministry of Agriculture) continued the statistics of sea fisheries as in former years. The "Bulletin statistique des pêches maritimes de Lettonie, année 1933" has been published. The statistical material for 1934 and 1935 will be published shortly.

Biology.

The Fisheries Laboratory (Ministry of Agriculture) continued the investigations of salmon and sea trout by marking experiments, and age and growth determinations by scale reading.

Also investigations were continued about the flounder and research with regard to the Baltic herring was taken up.

The Hydrobiological Station of the Latvian University (Director Prof. Dr. Embrik Strand) continued its researches regarding the fish and the plankton of water boardering the Latvian coast and of the Gulf of Riga. Several notes by B. Bersins were published.

Hydrography.

The Fishery Laboratory of the Ministry of Agriculture continued its hydrographical researches as in former years.

Two hydrographical cruises were carried out by the staff of the Laboratory, in spring and autumn, 1935. During the first cruise samples were collected and measurements carried out at 9 positions: at 4 positions in the Gulf of Riga, at 4 positions in the open Baltic along the Latvian sea shore and at 1 position at the Gotland Basin. During the autumn cruise explorations were made at 10 points: at 5 points in the Gulf of Riga, at 4 points in the open Baltic near the Latvian coast and at 1 point in the Gotland Basin.

During both cruises samples were collected in depths of 10 m. intervals in the Gulf of Riga and in the Baltic and 20 m. intervals at the Gotland Basin station. Determinations were carried out regarding temperature, salinity, oxygen, alkalinity, hydrogen-ion

concentration, phosphate and nitrogen compounds. The methods used have been described in the "Bulletin Hydrographique 1934".

The results of the investigations regarding the proportional coefficients of salt compounds relating to the Cl-ion were published by E. Zarins and J. Ozolins in the "Journal du Conseil, Vol. 10, No. 3" 1935. The results of the hydrographical cruises of the year 1934 were published in the "Bulletin Hydrographique".

The Marine Department of the Ministry of Finance continued water stage observations at the Latvian coast as in former years. The results of the observations are sent to the Hydrographical Service of the Council and partly published in the "Bulletin Hydrographique".

Measurements of sea current direction and velocity were continued by the Department as in previous years from the lightship at Ovizi. The results will be published shortly. Hydrographical measurements were continued at the W-coast of the Gulf of Riga, where considerable alternations of depth were observed near Kolkasrags.

The Meteorological Bureau of the Ministry of Agriculture continued ice observations and surface temperature measurements along the Latvian coast.

By the Hydrobiological Station of the Latvian University (Director Prof. Dr. Embrik Strand) surface observations of the sea regarding t° and S $^0/_{00}$ were regularly carried out approximately as in 1934. The observations were or are to be published in the "Bull. Hydrographique" and in the "Folia zool. et hydrobiologica", Vol. VIII, No. 2 (1935) and Vol. IX, No. 1, (1935).

Poland.

Biological investigations.

In connection with the hydrographical observations collected during the last ten years, variations of the time of appearance, of the periods of sexual maturity, of the time of disappearance of different components of the fauna near the Polish shore were studied. It was confirmed that Atlantic species appear in the neighbourhood of Hel and attain their sexual maturity in different months according to their more boreal or more meridional origin. For instance: *Ammodytes lanceolatus*, a north Atlantic species, has its spawning season by the end of June, in waters of a temperature of + 12.8° C.; the closely related but more meridional species *Ammodytes tobianus* spawns in August and at a temperature of 17° C.

The results of the study of the distribution of the bottom fauna near the Polish coast were published in "Archives polonaises d'Hydrobiologie et de Pêches".

Investigations into the qualitative composition of the fauna near the Gulf of Danzig revealed some new species not known till now in that part of the Baltic. Freshwater fishes: *Barbus barbus* L. and *Chondrostoma nasus* were found near Hel during the period of floods in the Vistula. The freshwater mollusc *Tropidiscus planorbis* was found in the Gulf of Puck, where also a pure marine opisthobranch *Alderia modesta* occurs. The marine *Polychaete Scoloplos armiger* was found in the deepest part of the Gulf of Danzig.

Studies on the parasites of fishes were continued. The results of investigations on the development of *Bothriocephalus scorpii* and on the influence of the change of external conditions upon the development of the eggs of the same parasite were published in "Bull. de l'Ac. polon. des Sciences", Kraków 1935. — Studies upon parasitic protozoa from fishes were published in the "Bull. de l'Inst. Océanogr. de Monaco". — Parasites of flounders and their development in different seasons in the year were studied.

A list of algae collected near the Polish shore was published in the "Bull. de l'Acad. d. Sci.", Kraków 1935.

Fisheries investigations.

Sprat. The investigations already begun last year were continued on a larger scale. The sprat fishery near the Polish coast is always increasing and attained in the season 1934/35 the quantity of 7,448 tons, what, in comparison with the period between 1923 and 1928, where the results of sprat-fishery were 736 — 2,685 tons only, signifies real progress. The fishery developed in the Gulf of Danzig and the quantity of sprat caught in these parts of the Baltic Sea, by all fishermen from Poland and from neighbouring countries, can be estimated as about 14,000 tons. Such rapid development and rapid exploitation of the stock of sprat makes investigations concerning the composition of the stock necessary in order to avoid effects of overfishing.

The analysis of the stock was based upon the examination of 24,290 individuals provided from 10 catches made in 1933/34. 84 $^0/_0$ of fish attained a length of more than 11.5 cm. (in 1931/32 only 34.5 $^0/_0$). The individuals of 12 cm. length formed 31 $^0/_0$ of the stock. Small sprat, 8 to 10 cm. long, never exceeded 10 $^0/_0$ of the stock. In addition to the increase of the bodylength, an increase of the average weight of sprat was recorded. The analysis of 1,000 individuals shows that the average weight was 10.5 gm. (in 1932/33 only 8 gm.). These facts can be explained as results of increasing fishery; the stock of sprat was thinned out by the intensive fishery and the conditions of nutrition of the rest of shoals improved. An approximative estimation of the number of individuals caught in the Gulf of Danzig shows that about 1 milliard of sprat were taken from the sea, a fact which must influence the conditions of life of the remaining stock.

The determination of age of sprat is very difficult, due to the fact, that sprat scales are attached very loosely, and therefore came from individuals with almost naked skin. The scales are also very difficult to read and it is necessary to have numerous scales from the same individual to obtain reliable results for

age determination. The otoliths are also difficult to read and a comparison of both methods of age determination is necessary. — For these studies sprat were caught by means of fixed nets. Every individual was, still living, carefully removed from the net still remaining in the water and was placed in a separate glass jar. 44 scales from every fish were placed on glass-slides and otoliths from the same individual were conserved in alcohol. This method allowed to obtain reliable results of age determination.

These investigations will be continued during next season. As to the study of otoliths the preliminary results show that a direct comparison of the structure of otoliths from the North Sea sprat with those from Baltic sprat does not give good results, the spawning period beginning 6 months earlier in the North Sea than in the Baltic. The first winter ring of the otoliths does not correspond to the first winter ring on the scale, the formation of the first ring on the otolith beginning already in the 5 to 6-month-old sprat while the first winter ring on the scales appears only in fishes 17 to 18 months old.

The determination of the quantity of fat in different months shows that the quantity of this substance varies from 3.57 % to 14.2 % in fresh sprat and from 18.39—46.44 % in dried specimens. The maximum of fat content occurs in December, in dried specimens 46.44 %, in March it was 40 to 42 %, in April 33—36 % and in June, during the spawning season 18.39 % only. The determination of fat in sprat from the Polish waters shows results quite different to similar analyses of Norwegian sprat made by Sund, but is easily explained by the fact that the Norwegian spawning season begins in January while in Polish waters it begins in June.

The distribution of the shoals was studied by the Marine Station with the assistance of fishermen; preliminary results of these investigations indicate that variations in the horizontal and vertical distribution are mainly due to changes of temperature of the sea water, caused by the action of winds and consequent currents. — The results of the fishery are dependent also on the velocity of the trawling.

Flatfish. Material concerning the migrations of flatfish, collected since 1928, were lately elaborated by the Marine Station. From 2,342 marked fishes, 8.5 % were recaptured.

The **flounder** from the Gulf of Danzig showed a tendency to long migrations extending to 120 miles and directed westwards. Rare exceptions only migrated toward the east or northeast. Flounders going to the west attain sexual maturity, pass the winter and spawn near Bornholm. After spawning they migrate toward the Oderbank. In deep parts of the Gulf of Danzig the flounder may pass the winter and spawns near the top of the Peninsula of Hel. From May, the flounders come to the shallow parts of the coast and to the Gulf of Puck in search of food.

The growth of flounders from the Gulf of Danzig and from the Western Baltic Sea was studied by Mr. Cieglewicz, and results were published in "Archives polon. d'Hydrobiologie et des Pêches". The principal results are as follows: Flounders show great individual variation in the rate of growth, the increase of body length being more intensive during the first 3 years than in following years. The average dimensions of the flounders in the western Baltic are greater than in the Gulf of Danzig; the last opinion is in accord with investigations by Kändler. Dimensions of fishes from shallow waters are smaller than those of individuals from deeper waters. — The parasites of flounders in different seasons of the year were studied. 1,350 individuals were carefully examined in this respect.

The venous system of flounders was studied and results were published.

Hydrography.

The report appears under the Hydrographical Committee.

Salmon and Sea trout.

See the report of the Salmon and Trout Committee.

Sweden.

During the year under review investigations at sea were carried out by the motorboat "Eystrasalt" and the research vessel "Skagerak".

The "Eystrasalt" was commissioned from May 6th to October 23rd and cruises were made to different parts of the Baltic along the Swedish coast.

The "Skagerak" made one cruise to the Baltic in September.

Biology.

Herring. A great number of herring samples from different parts of the Swedish coast were collected and examined as to race, length, maturity and age-composition. Through the courtesy of Director V. Miezis, Riga, a sample from the coast of Latvia also was analysed. This herring seems to be closely related to the herring of the Baltic west coast. The catch from Latvia as well as the catches from the Swedish coast consisted of autumn and spring spawners. On both sides of the Baltic the year-classes 1929 and 1930 dominated in the autumn and spring spawning herring respectively.

A more close study of the herring in the Archipelago off Stockholm, which has been going on in the previous years has been continued and the results are summed up by Dr. Chr. Hessle in a manuscript ready for printing. A similar investigation was commenced in the Gulf of Bothnia.

Flounder. Material for the study of the stock was collected at different regions of the coast. As a rule the fishing experiments gave good catches in the middle part of the Baltic. Late in summer and in the autumn many hauls were made on the east coast of Sweden and off the coast of Gotland in order to

collect samples of the 0- and I-Group. The catches f the 0-Group were smaller than in the previous year.

In the Bornholm Area along the coast of Blekinge nd Scania the 1935 year-class was much poorer than n 1934. The I- and II-Groups, however, were fairly bundant as the year-classes of 1934 and 1933 ere rich.

The material collected from previous years has been horoughly elaborated and the results have been repared by Dr. MOLANDER in a paper, which was aid before the meeting of experts in Copenhagen in December 1935 (not published, but kept in the rchives of the Council).

Plaice. In the year 1934 the 0-Group was exceptionlly abundant, while in 1935, it was again very poor long the coast of Blekinge and Scania. Many fishing xperiments were made, but the 0-Group was lacking n the coast of Scania. The I-group was fairly bundant, as was to be expected.

Cod. Samples were collected in different parts of the Baltic in order to study the stock. In the Bornholm Area on deep water the stock was extremely rich and the total quantity of the catches seems to have reached a maximum hitherto unequalled.

The stomach content has been examined in a great number of individuals.

Salmon and sea trout.

See the Salmon and Trout Committee report.

Plankton.

The quantitative investigations have been continued.

Hydrography.

The biological investigations have at all stations been connected with hydrographic observations.

HYDROGRAPHICAL COMMITTEE

1935.

Prof. MARTIN KNUDSEN.

Belgium.

. North Sea and E. Channel.

Monthly crossings with the Fishery cruiser "Zinnia" n the line Deal—Gravelines. Temperature obserations from surface to bottom.

Denmark.

orth Sea.

The "Dana" was commissioned from June 6th to 2nd on which date she was rammed by a German rawler and foundered near the Dogger bank. Most f the hydrographical data were saved and will ppear in the "Bulletin Hydrographique".

ransition Area.

Observations of temperature and salinity — and t a few stations of oxygen also — have been carried ut from the "Biologen" in close connection with the iological investigations, mainly during the months f April—May and October. Observations were made artly in the fjords and partly in the open sea. The tter part of the material will be published in the ulletin Hydrographique.

By the Danish Meteorological Institute regular ydrographical observations have been carried out s follows:

) Daily observations of temperature and salinity (by hydrometer) from 10 lightships and from 17 coast-stations.

2) 4-hourly observations of the surface current at 10 lightships.

These observations will be published in the Nautical-Meteorological Annual of the Institute.

England.

S. North Sea and Channel.

The routine collection of samples from the sea surface has been carried on as in earlier years. A new line of three samples a week (Folkestone—Boulogne) has been started in conjunction with the French authorities, and during the 1935/36 herring fishery an additional weekly sample has been taken near the French coast on the Newhaven—Dieppe line.

Hydrographic observations (salinity, temperature, oxygen, phosphate) have been made on twenty-one cruises of the research ships "George Bligh" and "Onaway" throughout the year. J. R. LUMBY.

Once again Drift-Indicator work has been in train throughout the entire year from the two English lightships "Varne" and "Cromer Knoll". A second report dealing with the Varne results has been issued[1])

[1]) CARRUTHERS, J. N. "The Flow of Water through the Straits of Dover, as gauged by continous Current-Meter observations at the Varne Lightvessel. (50°56′ N. —1°17′ E.)." Part II. Second Report on Results obtained. Min. of Agric. and Fish., Fish. Invest., Ser. II, Vol. XIV, No. 4, 1935.

taking account of the work up to Spring, 1935. In it no detailed attention is given to fishery applications of the data — which await treatment in a further report. A start has been made on a comparable report dealing with the Cromer Knoll observations.

The records from both lightvessels have been compounded as before and exactly similar wind data have been preserved.

Routine drift-bottle work has been much reduced and now consists of weekly liberations from the Smith's Knoll lightvessel and periodical (about every 10 days) liberations from a cargo steamer in mid-Channel at 1° W.

Further experiments with the short-period bottle systems have been made — over the area of the South-West Dogger Bank Swirl in April, and along the Flamborough line of plankton stations on three occasions. A paper on the use of these bottle systems is due to appear in a memorial volume being issued in Moscow in honour of Professor KNIPOVICH. The paper in question contains charts illustrating the circulation over the area of the South-West Dogger Bank Swirl in October 1932, July 1933, July 1934 and April 1935. The water movements were very far from being the same on these occasions.

During the year a new current-measuring apparatus has been put into use. This instrument which is called the "Vertical Log", has been described in print[1]), and a "Fisheries Notice" to serve as a simple manual of instructions is being written about it. The instrument was designed to enable all-weather continuous current-measurements to be carried out from steel vessels without having to trouble about the magnetic field of the observing vessel. Already considerable work has been done with it and it has been in use on the Smith's Knoll, Galloper and Sandettié lightvessels[2]). Aboard the two latter ships it has been in use in connection with routine tow-net work.

Arising out of the wish to see ample wind data become easily available in the form best suited to oceanographical needs, a design has been drawn up for an instrument to meet this wish[3]). Up to the present, this instrument has not been made.

As regards the flow of water past the Varne lightship during 1935, it is not yet possible to present a value for the whole year but it is clear that there has been still further departure from the conditions of 1932 and 1933. Whereas 1933 had only one month (January) with a bold flow into the North Sea, 1934 had four. In 1935, of the eleven months for which data are available, six are so describable, and only January, March, May and July were months of hold-up or reversal. Up to November, 1935, eight months have witnessed dominant S.W.'ly wind conditions. The three non-S.W.'ly months were January (N.W.), March (S.E.), and May (N.E.).

J. N. CARRUTHERS.

[1]) CARRUTHERS, J. N. "A 'Vertical Log' Current-Meter." Cons. Intern. p. l'Explor. de la Mer, Journ. du Conseil, X, 2, August, 1935. and see also in The Hydrographic Review, XII, 2, Monaco, 1935.

[2]) See the short paper elsewhere in the present issue of the Rapp. et Proc.-Verb., III, 1.

[3]) CARRUTHERS, J. N. "A Suggested Totalising Anemometer for Oceanographers." Hydrogr. Rev., XII, 1, Monaco, May, 1935.

Finland.

Baltic Area.

See Baltic Area Report.

France.

Atlantic.

The "Président Théodore Tissier" was commissioned from May 8th to July 15th, cruising the Bay of Biscay; the "Pourquoi-Pas?" has collected hydrographical data on the Atlantic Slope and on a cruise to Greenland in August, and the "Ailette" and "Quentin Roosevelt" have been engaged on hydrographical work in April/May and August/September respectively in the Atlantic, the English Channel and the North Sea. The "Ville d'Ys" has made a hydrographical Section along the 45° N. Lat. to Newfoundland in October.

Germany.

S. North Sea.

The regular hydrographic observations from German lightvessels in the North Sea have been continued as usual; the last publication deals with the observations of 1934.

During the "Poseidon" cruise of January 1935 in the Hoofden, hydrographical series were taken at 112 stations in addition to numerous surface observations; all observations were taken by Dr. ZORELL, Dr. KALLE, and Dr. GOEDECKE; the observations have sufficed to reconstruct the regional distribution of temperature and salinity as well as of further factors such as alkalinity, silicate, nitrite, phosphate, total phosphorus and diluted phosphorus. These series of observations were completed by the cooperation of the steamers "Portia", "Jessica" and "Hermia" who took hourly surface temperature observations and water samples for later determination of salinity on 12 voyages between Hamburg and London.

The investigations carried out by K. KALLE on the determination of the phosphorus etc. contained in salt water have been continued; they were published in a fourth and fifth communication: The influence of chemical constituents upon the determination of phosphorus content (Ann. d. Hydrogr., 1935, p. 58—65) and: the determination of the total phosphorus content, the plankton phosphorus content (living substance) and opacity measurements (Ann. d. Hydrogr., 1935, p. 195—204). B. SCHULZ.

Baltic Area.

The cruises in spring of the "Poseidon" (14. III—3. IV) were arranged for a thorough investigation of the Bornholm basin. 91 hydrographical stations,

irly evenly distributed over the entire area, were one and many of them subject to two sets of observations at short intervals of time. In addition to temperature and salinity, observations on oxygen, phosphate, nitrate, alkalinity, and pH-ion concentrations as well as colour and light penetration were made. The work was carried out by Professor Schulz, Drs. Kalle, Goedecke, R. Hatje and O. Hatje.

See also the respective Area Reports.

Holland.

North Sea.

The regular observations have been continued as before:

Salinity observations. Kon. Ned. Meteor. Instituut, De Bilt.

1) 4-hourly observations of surface temperature and daily observations of surface salinity. (Decade means in Bulletin Hydrographique).

Lightships Noord-Hinder, Haaks en Terschellingerbank.

2) 4-hourly observations of surface temperature. Decade means in Bulletin Hydrographique).

Lightship Maas.

3) Regular temperature and salinity observations at fixed stations on the following steamship routes. Decade means in Bulletin Hydrographique).

Vlissingen—Harwich,
Hoek van Holland—Gravesend,
IJmuiden—Hull.

Surface and deep water observations.

H. M. S. "Nautilus". Serial observations carried out in June and July 1935 by Dr. J. J. Tesch. Temperature and salinity observations at 30 stations between Orkney and Shetland islands, between the Otter and the Norwegian coast, in the Skagerak between Norway and Denmark and in the region to the east of Scotland.

The titrations have been carried out at the Rijksinstituut voor Chemisch, Microbiologisch en Hydrografisch Visscherijonderzoek, Den Helder, Director F. Liebert.

Irish Free State.

Atlantic Slope.

The customary cruises of the "Muirchu" have been carried out in February, May and August.

Latvia.

Baltic Area.

See Baltic Area Report.

Norway.

N. E. Area.

Three institutions in Norway have occupied themselves with oceanographical work in 1935, viz.: The Fisheries Directorate, the Geophysical Institute of the Bergen Museum and the Tromsø Museum.

1) The Fisheries Directorate (Bergen) had the fishery research cutter "Johan Hjort" in commission from Jan. 17th to Nov. 21st and in addition hired the vessel of the Geophysical Institute for several months. The amount of observational work is seen from the following table:

Between dates:	No. of stat.	Number of observations T + S	Oxyg.	pH	P	Region
an. 17th—May 2nd	93	694	38	—	—	West Coast and North Sea
ept. 21st—Nov. 7th	68	548	217	44	209	
lay and Nov.	49	329	49	47	39	West Coast Fjords
eb. 22nd—May 1st	43	399	186	194	66	C. Stat to Vikna (Møre and
ov. 3rd—5th	7	76	76	72	64	Trøndelag)
arch 3rd—Apr. 5th	68	582	312	349	120	Nordland
uly 13th—Aug. 18th	42	224	135	—	—	
ept. 25th—Nov. 3rd	74	686	656	617	631	
pr. 10th—15th	15	147	88	62	—	Troms fylke
ug. 12th—14th	20	229	102	—	—	
ept. 27th—Oct. 10th	20	209	174	150	139	
Total...	499	4125	2033	1535	1268	

Thermograph records were obtained from six liners running on the following routes from Bergen:

1. To Reykjavik via Faroes ..... Fortnightly
2. - — - North Iceland ... Monthly
3. - Rotterdam ..... Fortnightly
4. - Newcastle ..... Weekly
5. - Oslo ..... do.
6. - Kirkenes (East Finmark) ..... Fortnightly

Route No. 2 is not run in the months Dec. to Feb. incl.

Salinity samples are collected on these lines in Feb., May, Aug. and Nov., on route No. 2 in March instead of February.

Periodical observations at the customary depths were made at 3 fixed stations, namely at Sognesjøen (at the mouth of the Sognefjord), at Skråva in the West Fjord and at Eggum on the west side of Vestvågø, Lofoten. A fourth station will be taken up in 1936, probably near Ingøy in Westfinmark.

2) The Geophysical Institute (Bergen).

The vessel of the Institute, the "Armauer Hansen" was employed for fortnightly observations in the Byfjord and monthly obs. in other fjords in the periods Jan. 3rd—May 29th and July 26th—Dec. 19th, oxygen being observed in addition to salinity and temperature.

A cruise in the Northern North Sea and in the Norwegian Sea as far as Lat. 69° N. comprising 199 stations with observations of T, S, O, pH and phosphates was executed between May 30th and July 22nd.

Observations on the penetrating radiations from space were made between Aug. 1st and 12th.

Observations on currents and internal waves were made between Aug. 15th and 24th.

3) Tromsø Museum (Tromsø).

During 1935 the habitual programme of monthly observations at 7 selected places in the Tromsø region was continued. The elements observed are enumerated below. For these investigations the research vessel of the Museum, the "Sparre Schneider", was used.

In March—April a six-weeks cruise was made on behalf of the Fisheries Directorate in the hired motor cutter "Sverre" to the waters of West Finmark from Loppa to the Porsanger Fjord, ending with a section across the edge of the continental shelf from Vesterålen to a distance of about 50 naut. miles, with observations of T, S, O, pH and P.

In all the following number of observations were made: T: 1121, S: 1108, O: 1072, Oxygen consumption: 613, pH: 1042, phosphate: 1002, nitrate: 522, nitrite: 527, ammonia: 212, alkalinity: 248.

4) The Flødevig Sea Fish Hatchery (Arendal).

This institution (which is a branch of the Fisheries Directorate) disposes of a small motor vessel for oceanographical and other investigations along the South coast. In 1935 observations were carried out at 139 stations in fjords and coastal waters.

5) Norges Svalbard- og Ishavsundersøkelser (Oslo).

Two charting expeditions were carried out in Arctic waters during the summer of 1935. 1) To Davis Straits and West Greenland under Capt. von Krogh in the "Korsvik" which was fitted with a recording magnetostriction sounding machine. By means of this an aggregate course length of 2760 naut. miles was sounded continuously. At the fishing stations of the vessel, wire soundings around the stations were made by means of a motor dory fitted with a Lucas machine. In all 225 naut. miles were covered by wire-sounding courses. 2) To West Spitsberg a special sounding expedition, the "Veslekari" was sent, fitted with the same kind of echo gear as the "Korsvik". The whole bank area along the island in a length north south of 350 km. and east west of 100 km. was covered by parallel east west profiles at intervals of 10, sometimes 5 naut. miles, an aggregate length of profiles, with occasional wire soundings, of 1860 naut. miles. The results are embodied in a new chart in 1:350000, appearing in 1936. See: Norges Svalbard- og Ishavsundersøkelser, Medd. nr. 32, N. Geogr. Tidsskr. b. V, h. 8, Oslo 1935.

Poland.

Baltic Area.

I. The Marine Department of the State Meteorological Institute at Gdynia continued regular observations as follows:

1) Surface temperature and salinity daily at 3 coastal stations.

2) Surface temperature and salinity made from liners between Gdynia—Stockholm and Gdynia—Kattegat.

3) Registration of the sea level at 1 station and reading of the sea level at 2 stations.

4) Registration of the bottom temperature (40 m.) by means of the bottom termograph at 1 station.

5) Currents by means of drift-bottles put out from the liners between Gdynia—Stockholm and Gdynia—Kattegat.

II. Hydrographical data concerning surface t° and S ‰ were collected at 400 stations from September 1934 to September 1935 by the training ship "Dar Pomorza" during the round-the-world cruise: English Channel—Panama—Galapagos—Honolulu—Jokohama—Batavia—Durban—Cape of Good Hope—English Channel.

Portugal.

Atlantic Slope.

No report received.

Scotland.

N. E. Area.

The work of the "Explorer" during April 1935 occasioned the occupation of two deep water 'stations' off the Norwegian coast in the vicinity of Bergen, while further work was carried out in the adjacent waters of the Northern North Sea on the Continental Plateau. Drift bottle liberations were carried out in conjunction with temperature and salinity observations. The former have already yielded some interesting results, as, for example, the recovery in the outer waters of the Moray Firth in August of a

drift bottle liberated immediately south of Viking Bank on April 15, 1935. Further indications are that bottles thrown overboard within 40 miles of the Norwegian coast were first of all carried round the Great Northern North Sea eddy before being stranded on the Norwegian coast between latitudes 59° N. and 61° N. where a concentration of drift bottle recoveries took place chiefly in the months of October and November.

N. W. Area.

The **hydrographic data** will appear in the "Bulletin Hydrographique". Hydrographical work comprised the collection of temperature and salinity observations from all depths and the liberation of a large number of surface drift-bottles. A remarkable number of the latter have not yet been recovered, while a feature of those which have been returned is the comparatively short periods occupied in coursing from the north-eastern part of the Faroe-Shetland Channel to northerly Norwegian latitudes. Remarkably few bottles appear to have entered the Northern North Sea. Some explanation of these circumstances is contained in Mr. J. B. Tait's report to the Hydrographical Committee. Normally the main Atlantic stream which moves north-eastwards over the Faroe-Shetland Channel keeps largely to the eastern side of the Channel and is guided by the contour of the continental shelf, but as Scotland's contribution to the Hydrographic Committee shows, there was a damming back of this current during the main spring-summer influx and that the main bulk of the waters was deflected in a north-westerly direction in the region of the Wyville-Thomson Ridge. The data from the Faroe stations again suggest that an offshoot of the warmer Atlantic water tends to spread first round the western side of the islands and later affects the temperature conditions on the east side. This cycle of hydrographic events has a direct bearing on the biological conditions and explains the divergence in the range of size of haddock at the west and east sides of the Islands.

The "Explorer"'s echo sounder registered for the fourth time since 1929 a depth of over 400 fathoms between Faroe Bank and Suderö. On Close's Fisherman's Chart "Scotland to Iceland" and on Admiralty Chart No. 2 the greatest depth in this area is 242 fathoms, while only a few miles to the southward a bank of less than 100 fathoms is shown. The actual position on this cruise during June 1935 was fixed at 61°09′ N. 7°24′ W. and the recorded depth was 448 fathoms. R. S. Clark.

N. North Sea.

The cruises overtaken by the research vessel "Explorer" during 1935 embraced the following regions in the months stated:—

March.	North-western part of the North Sea.
April.	Northern North Sea, latitudes 57° N. to 61° N., longitudes 2° W. to 4°30′ E.
May.	(a) Middle North Sea, latitudes 56° N. to 57° N. and eastward from the Scottish coast to longitude 2°30′ E. (b) North of Scotland region to the west of Orkney.
June.	North-Western North Sea, Faroe-Shetland Channel and Faroe Bank to Butt of Lewis area covering the Wyville-Thomson Ridge.
July.	West Scottish coast, outer and inner areas, including Firth of Clyde.
August.	Middle North Sea from Scotland to Denmark, between latitudes 55° N. and 58° N.
Sept.-Oct.	North-western part of the North Sea.
Nov.-Dec.	Mid-east Scottish coast area eastward to longitude 1° E.

In hydrography, attention was confined throughout the year to currents and to temperature and salinity distributions, from which the following broad statement of conditions in the Northern North Sea in 1935 can be made.

Atlantic influence was weaker than it has been for some years, though evidently still somewhat above the average over a long period of years. The whole cause of this does not apparently lie in a markedly weaker Atlantic current heading towards the Faroe-Shetland Channel, as salinities obtained in the months of June and July in the neighbourhood of the Wyville-Thomson Ridge show. There is evidence from other sources of increased Polar activity in the early part of 1935 which seems to have resulted in a more southerly extension of the usual Norwegian Sea anticyclonic circulation, bringing this within nearer reach than is usually the case in summer, of the Faroe, and even of the Shetland Islands. The effect upon the Atlantic current was apparently to dam its flow across the Wyville-Thomson Ridge, causing the bulk of its waters to be deflected from a north-easterly to a north-westerly course in the direction of Faroe. A further consequence of this abnormal resistance from the north was to deflect an unusual amount of the Atlantic water south of the Wyville-Thomson Ridge, in upon the west coast of Scotland.

The results of the surface drift-bottle liberations conducted throughout the year contribute largely towards the above interpretation of temperature and salinity distributions. They further indicate that the maximum intensity of the Atlantic inflow to the Northern North Sea in 1935 was not attained until the month of June, that is, at least two months later than is customarily expected in this region. Incidentally, this and other deductions confirm the anticipation of last year's report to this Committee, to the effect that the incidence of spring hydrographic conditions in the northern area in 1935 would probably be delayed. John B. Tait.

Sweden.

Transition Area.

In addition to the usual coastal observations, hydrographical observations have been made from

the R/V "Skagerak" in the Kattegat near the Fladen L. V. from August 3rd to 15th and in Skagerak during brief cruises in October, November, and December.

The investigations into internal waves, light-penetration and radioactivity have been continued, as also the usual serial observations from the L. V.s Svinbådan, Fladen and Vinga.

Spain.

Atlantic.

No hydrographical work during 1935.

REPORTS FROM CHAIRMEN OF SUB-COMMITTEES

Referring to the Procès-Verbaux of last year's meeting (Vol. XCIV, pp. 33 and 51) the following reports have been received from Chairmen of Sub-Committees:—

1) The Sub-committee for the purpose of considering future work to be carried out by the Service Hydrographique (1934).

As reported by the Administrative Secretary, hydrographical data on temperature and salinity published in the Bulletin Hydrographique have been recorded on index cards and arranged consecutively within squares of 1° Lat. and 1° Long., in accordance with the principle applied in the last three issues of the Bulletin. — The work covers Atlantic waters, viz., west of 5° W. at the entrance to the English Channel, west of 5° W. north of Scotland to 60° N. and all observations north of 60° N. (i. e., the North Sea, the Transition and Baltic Areas are not indexed). — Up to date all observations recorded in the Bulletin Hydrographique and Rapport Atlantique from 1902 to 1924 and from 1932—1934 have been arranged in the index; the remaining interval, 1925—1931, is expected to be ready in a few months' time, and a summary of the numbers of observations will then be prepared for the Committee for purpose of deciding what areas may be recommendable for further treatment.

Mr. Lomholt has continued his preparation of TS-diagrams for stations in the Faroe-Shetland district. The preliminary result of this work seems to show such strong mixing of waters in this area that no simple picture of normal hydrographical conditions is immediately deductable.

2) The Sub-committee for the purpose of considering the Chemical Nomenclature to be used in the Council's publications (1934).

At the request of the members of the Sub-committee Dr. Jacobsen has prepared a new proposal for the nomenclature with tables and diagrams for the conversion of the different indications to one another. The proposal has been sent out in January to the collaborators of the Sub-committee and to other experts for their consideration. The proposal is included as an appendix to this report.

3) The Sub-committee for investigating the possibility of extending observations in the Northern Atlantic-Arctic Region (1935).

After communications with the "Deutsche Seewarte", the Danish and the Norwegian Meteorological Institutes, the members of the Sub-committee have been informed as to the possibility of extending hydrographical observations in the northern Atlantic.

4) The Sub-committee for investigating the possibility of establishing international co-operation on an investigation of the water-exchange between the Baltic and the Kattegat (1935).

At the initiative of "Kommissionen for Danmarks Fiskeri- og Havundersøgelser" investigations in the section Gjedser—Darss, in Fehmarn Belt, and in the Sound have been commenced and are planned to last for a period of two months. The results of these investigations are expected to give a valuable supplement to our present knowledge on the water-exchange between the Baltic and the Kattegat.

5) The Sub-committee for drafting a brief review of the different methods of determining nutrient salts and connected constituents in sea water (1935).

Aufgabe: Prüfung des gegenwärtigen Standes der Methodik, besonders hinsichtlich der Möglichkeit einer Standardisierung, wie sie z. B. für die Bestimmung des Salzgehaltes seinerzeit durchgeführt worden ist. Die Prüfung erstreckt sich auf: PO'_4, NO'_3, NO'_2 NH_3, SiO_2, Fe, org. P und org. N.

Vorbemerkungen: Um auch die Erfahrungen der Amerikaner verwerten zu können, wurden Prof. Th. G. Thompson (Seattle) und Prof. N. W. Rakestraw (Woods Hole) gebeten, an dem schriftlichen Meinungsanstausch teilzunehmen. Es erwies sich ferner als vorteilhaft, den Bericht über die pH-Bestimmung im Seewasser abzutrennen und Herrn Prof. Buch allein die Abfassung zu überlassen.

An die Mitglieder der Subkommission und die hinzugezogenen amerikanischen Wissenschaftler wurde vom Vorsitzenden ein Fragebogen verschickt, der alle diejenigen Fragen enthielt, deren Beantwortung für die Bearbeitung der Aufgabe erforderlich erschien. Aus dem umfangsreichen Ergebnis der Rundfrage sind im folgenden die wichtigsten Punkte kurz wiedergegeben:

1. Standard-Vorschriften. Es besteht offenkundig Einigkeit darüber, dass Standardvorschriften zur Zeit nicht aufgestellt werden sollen. Man würde dadurch den Eindruck erwecken, als ob es möglich wäre, wie beim Salzgehalt nach einem allgemein gültigen Rezept zu arbeiten. Dies ist nicht möglich. Vielmehr muss davor gewarnt werden, die Nährstoffmethoden anzuwenden, ohne dass sich der Beobachter jederzeit über alle möglichen Komplikationen im klaren ist. Prof.

Thompson tritt dafür ein, dass nur geübte Chemiker diese Methode benutzen, damit die Literatur nicht mit unzuverlässigen Zahlen belastet wird.

2. Kolorimetrierung. Da alle Methoden auf der Messung der Intensität einer chemisch hervorgerufenen Farbe beruhen, konnte man wenigstens auf diesem Gebiete die Möglichkeit einer Standardisierung sehen. Aber auch bei dieser physikalischen Messung ist man jedoch noch weit entfernt von einer einheitlichen Methodik. Dies liegt z. T. an der persönlichen Gewöhnung an ein Verfahren und anderen äusseren Gründen, z. T. aber auch daran, dass sich ein wirklich bestes Verfahren noch nicht herausgebildet hat. Vom einfachen Hehner-Zylinder bis zum Pulfrich-Photometer und photoelektrischen Photometer sind alle nur denkbaren Apparate im Gebrauch. Es scheint, als ob die beiden letzteren Instrumente neuerdings mehr in Aufnahme kommen, das Pulfrich-Photometer wegen der grossen absoluten Genauigkeit und der Unabhängigkeit von störenden Färbungen, das elektrische Photometer wegen der Ausschaltung aller persönlichen Fehler.

. Bemerkungen zu den einzelnen Methoden.

Phosphat: Die altbewährte Phosphat-Methode nach Atkins-Denigès ist wohl die zuverlässigste unter den Nährstoffmethoden. Trotzdem gibt es auch hier Störungsmöglichkeiten, die beachtet werden müssen. Ob es neben dem Kupfer-Effekt noch eine Beeinflussung durch den Salzgehalt gibt, ist noch nicht entschieden.

Silikat: Bei der Kieselsäure-Bestimmung kommen am wenigsten Komplikationen vor. Allerdings werden gegen den bisher gebräuchlichen Pikrinsäure-Standard Bedenken erhoben (Cooper); es wird statt dessen Kaliumchromat empfohlen.

Nitrat: a) Die Ansichten über die Strychnin-Methode gehen sehr stark auseinander. Von einigen Forschern (Thompson; Canadian Biol. Station) wird sie ganz abgelehnt, von anderen sehr empfohlen (Cooper, Rakestraw); letztere haben umfassende systematische Untersuchungen darüber angestellt. b) Mit Diphenylbenzidin sind wenige, aber gute Erfahrungen gemacht worden, wenn die Vorschriften von Atkins genau beachtet wurden.

Nitrit: Mit der üblichen Methode von Gries-Ilosvay sind fast alle Beobachter zufrieden. Neuerdings sind gute Erfahrungen mit einer anderen Methode gemacht worden, in der Indol als Reagenz verwendet wird (Kalle); sie ist zwar etwas weniger empfindlich, aber unabhängig von der Temperatur.

Ammoniak: Drei Verfahren sind im Gebrauch, ein Zeichen dafür, dass eine wirklich befriedigende Methode noch nicht existiert. a) Fällungsmethode (Buch und Witting), b) Weinsäuremethode (Wattenberg), c) Destillation im Vacuum (Krogh). Die zweite Methode ist am bequemsten, die dritte am zuverlässigsten und genauesten, sie erfordert aber einige experimentelle Übung.

Organ. Phosphor: Die starken Meinungsverschiedenheiten über die bisher im Gebrauch befindlichen Methoden (Kalle, Seiwell, Kreps u. a.) lassen darauf schliessen, dass diese Verfahren nicht einwandfrei sind. Es ist festgestellt worden, dass hiermit nur $^2/_3$—$^3/_4$ des im Wasser vorhandenen Phosphors gefunden wird (Rakestraw). Ein neues Verfahren wurde ausgearbeitet, das sämtlichen Phosphor erfasst (Homer Smith, Providence U.S.A.).

Organ. Stickstoff: Man unterscheidet zwischen sog. "Albuminoid-Stickstoff", der durch Kochen mit alkalischem Permanganat als Ammoniak ausgetrieben wird (Wanklyn, Chapman und Smith) und eigentlichem organisch gebundenen Stickstoff, der erst durch Eindampfen mit konzentrierter Schwefelsäure in Ammoniak verwandelt wird (Kjeldahl). Beide Verfahren sind nicht sehr befriedigend, und es sind nur wenige Analysen damit ausgeführt worden (Robinson). Kürzlich hat Krogh ein neues Verfahren für Gesamtstickstoff angegeben, bei dem 5 ccm. Seewasser im Silberrohr über Alkali verdampft und der Rückstand im Wasserstoffstrom auf 500° erhitzt wird. Erfahrungen sind dem Subkomitee nicht bekannt geworden.

Eisen: Eisen liegt im Seewasser nur zum geringsten Teil in gelöster Form vor (unter 2 mg./cbm.), zum weitaus grössten Teil in ungelösten Partikeln oder in kolloider Form. Die neuen Bestimmungsmethoden (Thompson und Bremner mit Kaliumthiocyanat, Cooper mit Tripyridyl) sind bisher nur von den Autoren angewendet worden, sodass eine Beurteilung noch nicht möglich ist.

Schlussbemerkung: Um denjenigen, die Nährstoff- usw. Bestimmungen ausführen oder ausführen wollen, eine schnelle Übersicht über den gegenwärtigen Stand der Methodik zu ermöglichen, wird vorgeschlagen, dem Subkomitee die Abfassung eines ausführlichen kritischen Berichts zu übertragen und diesen Bericht in den "Rapports et Procès-Verbaux" zu veröffentlichen[1]). In diesem Bericht wäre besonders auf Schwierigkeiten und Störungsmöglichkeiten hinzuweisen, um die Beobachter von einem schematischen Arbeiten abzuhalten und um eine ständige Kontrolle zu veranlassen. Dieser Bericht wäre zugleich ein Leitfaden der Bestimmung von Nährstoffen und ähnlichen Verbindungen im Seewasser, für den nach der Ansicht des Subkomitees ein Bedürfnis besteht.

[1]) See this Vol., 1st part, p. 16.

NOMENCLATURE AND UNITS

for

Indication of the Amount of Constituents of Seawater.

Preliminary Report from the Sub-committee for Consideration of the Chemical Nomenclature, issued to a series of Institutions and experts for practical trial and criticism.

Introduction.

Contributions to the question on the chemical nomenclature to be used in the oceanographical literature have been given in publications by: Neal M. Carter, Erik G. Moberg, Tage Skogsberg and Thomas G. Thompson in Proceedings of the Fifth Pacific Congress, Victoria and Vancouver, B.C. Canada, 1933, L. N. Cooper in Journal du Conseil Vol. VIII page 331, 1933 and Kurt Kalle in Annalen der Hydrographie 1935, page 18. At the meeting of the Hydrographical Committee of the Council in June 1934 a Sub-committee for "Consideration of the chemical nomenclature to be used in the publications of the Council" was appointed[1]). The members of this Sub-committee are: Dr. J. P. Jacobsen (Chairman), Professor K. Buch, Professor B. Schulz and Dr. H. Wattenberg. In 1934—35 the appointed Sub-committee took up its work by correspondence and collaborated — also by correspondence — with different scientists, namely: Dr. W. R. G. Atkins, Plymouth, Professor H. B. Bigelow and Professor N. W. Rakestraw, Woods Hole, Dr. K. Kalle, Deutsche Seewarte, Professor T. G. Thompson, Seattle, and Director Neal M. Carter and Dr. H. B. Hachey, Canada.

On the basis of the contributions, partly in the publications mentioned above, partly from the members of the Sub-committee and its collaborators a provisional scheme was worked out for treatment at the sitting of the Sub-committee at the Council meeting in 1935.

At that meeting the provisional scheme was discussed by the Hydrographical Committee and by the Sub-committee[2]). At the sitting of the Sub-committee the following points were agreed upon:

Amounts of major constituents viz: chloride, sulphate, borate, magnesium and calcium as well as alkalinity should be indicated per kilo seawater.

Amounts of other constituents should be indicated per litre seawater at 20° C.

Amounts of major constituents should be expressed in grammes of the ions viz. Cl', SO_4'', BO_3''', $Mg^{\cdot\cdot}$ and $Ca^{\cdot\cdot}$.

The alkalinity should be expressed in milliequivalents.

Amounts of gases should be expressed in *ml* at 0° and 760 mm *Hg* (0°, 45° N. Lat.).

Amounts of minor constituents — especially the nutrient salts — should be expressed in *g*-atoms (*mg*-atoms or μg-atoms) of the characteristic element in the compound.

Designations as for instance "Phospate-*P*" were to be used in preference to "PO_4'''-*P*".

It was further suggested that tables for transferring indications "per kilo" to indications "per litre" and vice versa would be of principal interest.

The Chairman of the Sub-committee was asked by the members to prepare a new proposal for the nomenclature and the units to be used in the oceanographical literature and to have this new proposal reconsidered by the members of the Sub-committee. Afterwards the reconsidered scheme should be sent to experts interested.

The reconsidered scheme is given on the following pages as a **proof** for further considerations. It is divided into two parts:

I. Formulae and tables for conversion between indications of the amounts of a constituent relative to different amounts of seawater viz. 1 kg. seawater and 1 litre seawater at different temperatures.

II. Significations and units for the indication of the different constituents of seawater relative to the amount of seawater adopted for common use.

By means of the scheme presented it should be easy to convert the different indications to one another.

I. Conversion of indications of the amount of a constituent relative to different amounts of seawater viz. 1 kg. seawater and 1 litre seawater at different temperatures.

The "litre" to be used is the "true litre" i. e. the volume of 1 kg. of pure water at 4° C.

By the conversion here in question it has to be remembered that — in the indication "amount of a constituent per litre seawater at a definite temperature" — the expression "litre seawater at a

[1]) Rapp. et Proc. Verb. Vol. LXXXIX Ière partie, page 38.
[2]) Rapp. et Proc. Verb. Vol. XCIV Ière partie, page 33.

definite temperature" is an indication of the amount of the seawater only. A change, if any, of the concentration of a constituent with the temperature has no relation to the conversion in question.

A. Significations used in the formulae below.

S: The salinity of a seawater sample defined by means of the chlorinity Cl viz. by $S = 0.030 + 1.8050\ Cl$ (Knudsen's tables).

σ_t: $\sigma_t = (s_{t/4} - 1) \times 10^3$, where $s_{t/4}$ means the density of the seawater at $t°$ C in relation to destilled water at 4° C.

φ_t: $\varphi_t = \left(\frac{1}{1 + \frac{\sigma_t}{1000}} - 1\right) \times 10^3$.

r_t: Abbreviation for $r_{20,t} = \left(\frac{1 + \frac{\sigma_t}{1000}}{1 + \frac{\sigma_{20}}{1000}} - 1\right) \times 10^3$.

Q_{kg}: The amount of a constituent per kilo seawater.

Q_{L_t}: The amount of a constituent per litre seawater at $t°$ C.

For a seawater sample at the temperature t we have the following relations:

$$\left.\begin{aligned} Q_{kg} &= \frac{Q_{L_t}}{1 + \frac{\sigma_t}{1000}} = Q_{L_t}\left(1 + \frac{\varphi_t}{1000}\right) \\ &= \frac{Q_L}{\left(1 + \frac{\sigma_{20}}{1000}\right)\left(1 + \frac{r_t}{1000}\right)} = Q_L \frac{1 + \frac{\varphi_{20}}{1000}}{1 + \frac{r_t}{1000}}. \end{aligned}\right\} \quad (1)$$

The quantities r_t, σ_{20} and φ_{20} are tabulated in tables 1, 2 and 3 respectively.

B. Formulae of conversion.

1) Given: The amount Q_{L_t} of a constituent per litre seawater at $t°$ C.
required: The amount Q_{L_T} of a constituent per litre seawater at $T°$ C.

By means of the relations (1) we get:

$$Q_{L_T} = Q_{L_t}\left(1 + \frac{r_T - r_t}{1000} - \frac{\frac{r_t}{1000} \cdot \frac{r_T - r_t}{1000}}{1 + \frac{r_t}{1000}}\right). \quad (2)$$

For the temperatures and the salinities in table 1 the numerical value of the term $\frac{\frac{r_t}{1000} \cdot \frac{r_T - r_t}{1000}}{1 + \frac{r_t}{1000}}$ in all cases will be less than *0.000023*.

In the term $\frac{r_T - r_t}{1000}$ — when computed from table 1 — there may be an error of *0.0002* on account of rounding off of figures. When used in connection with table 1 the formula (2) therefore may be replaced by the approximative formula

$$Q_{L_T} = Q_{L_t} + Q_{L_t} \cdot \frac{r_T - r_t}{1000}. \quad (3)$$

2) Given: The amount Q_{L_t} of a constituent per litre seawater at $t°$ C.
required: The amount Q_{kg} of a constituent per kilo.

By means of (1) we get:

$$Q_{kg} = Q_{L_t} \cdot \left(1 + \frac{\varphi_{20} - r_t}{1000} - \frac{\frac{r_t}{1000} \cdot \frac{\varphi_{20} - r_t}{1000}}{1 + \frac{r_t}{1000}}\right). \quad (4)$$

For temperatures and salinities in tables 1 and 3 the numerical value of the term $= \frac{\frac{r_t}{1000} \cdot \frac{\varphi_{20} - r_t}{1000}}{1 + \frac{r_t}{1000}}$ in all cases will be less than *0.00011*.

Calculation of the term $\frac{\varphi_{20} - r_t}{1000}$ by means of the tables 1 and 3 may involve an error of *0.0002* in the result on account of rounding off of figures.

If errors less than *0.0003* in the ratio $\frac{Q_{kg}}{Q_{L_t}}$ may be disregarded the tables 1 and 3 may be used for computing the quantities φ_{20} and r_t and the formula (4) be replaced by the approximative formula:

$$Q_{kg} = Q_{L_t} + Q_{L_t} \cdot \frac{\varphi_{20} - r_t}{1000}. \quad (5)$$

The expression $\frac{\varphi_{20} - r_t}{1000} - \frac{\frac{r_t}{1000} \cdot \frac{\varphi_{20} - r_t}{1000}}{1 + \frac{r_t}{1000}}$ in formula (4) is equal to $\frac{\varphi_t}{1000}$ and refers to a water sample with the salinity S. We may ask for the salinity S' of a water sample for which the φ_{20}-value — to be designated by $\varphi_{20,S'}$ — is equal to the φ_t-value — to be designated by $\varphi_{t,S}$ — for a water sample with the salinity S.

Values of the differences $S' - S$ for different temperatures and salinities have been calculated and are tabulated in table 4.

For computing Q_{kg} from Q_{L_t} we may find the value $S' - S$ from table 4, add this value to the salinity S and by means of S' find the value $\varphi_{20,S'}$ from table 3. We then have:

$$Q_{kg} = Q_{L_t} + Q_{L_t} \cdot \frac{\varphi_{20,S'}}{1000}. \qquad (6)$$

3) Given: The amount Q_{kg} of a constituent per kilo seawater.
required: The amount Q_{L_t} of a constituent per litre seawater at $t°$ C.

By means of (1) we get:

$$Q_{L_t} = Q_{kg}\left(1 + \frac{\sigma_{20} + r_t}{1000} + \frac{\sigma_{20}}{1000} \cdot \frac{r_t}{1000}\right). \qquad (7)$$

For the temperatures and the salinities in the tables 1 and 2 the numerical value of the term $\frac{\sigma_{20}}{1000} \cdot \frac{r_t}{1000}$ in all cases will be less than *0.0001*. Calculation of the term $\frac{\sigma_{20} + r_t}{1000}$ by means of the tables 1 and 2 may involve an error of *0.0002* in the result on account of rounding off of figures.

If errors less than *0.0003* in the ratio $\frac{Q_{L_t}}{Q_{kg}}$ may be disregarded the tables 1 and 2 may be used for computing the quantities σ_{20} and r_t and the formula (1) may be replaced by the approximative formula:

$$Q_{L_t} = Q_{kg} + Q_{kg} \frac{\sigma_{20} + r_t}{1000}. \qquad (8)$$

The expression $\frac{\sigma_{20} + r_t}{1000} + \frac{\sigma_{20}}{1000} \cdot \frac{r_t}{1000}$ in formula (7) is equal to $\frac{\sigma_t}{1000}$ and refers to a water sample with the salinity S. We may ask for the salinity S' of a water sample for which the σ_{20}-value — to be designated by $\sigma_{20,S'}$ — is equal to the σ_t-value — to be designated by $\sigma_{t,S}$ — for the water sample with the salinity S. If $\sigma_{20,S'} = \sigma_{t,S}$ then also $\varphi_{20,S'} = \varphi_{t,S}$. The difference $S' - S$ therefore may be determined by means of table 4.

For computing Q_{L_t} from Q_{kg} we may find the value $S' - S$ from table 4, add this value to the salinity S and by means of S' find the value $\sigma_{20,S'}$ from table 2. We have then:

$$Q_{L_t} = Q_{kg} + Q_{kg} \frac{\sigma_{20,S'}}{1000}. \qquad (9)$$

C. Methods for the practical computations — Construction of nomograms.

According to formulae (3), (5), (6), (8) and (9) the computation of the required quantity may be carried out by adding the value of the last term in the formulae to the given quantity.

The computation of the last term in the cited formulae involves a multiplication of two figures. In several cases this multiplication may be carried out mentally with sufficient accuracy. In other cases it may be practical to use a table for multiplication or a slide rule.

For routine work the use of nomograms for computation of the last term in the cited formulae may be of some value.

The construction of a nomogram for computing Q_{kg} when $Q_{L_{20}}$ is known may be carried out in the following way:

Take a piece of drawing paper of a size ca. 35×25 cm.^{2}. Draw on this paper a rectangle limited by lines of the lengths 31, 31, 19 and 19 cm. Draw parallel to the two long sides of the rectangle a line with equal distance from each of two long sides. Mark the two long sides of the rectangle with n and S respectively and the line parallel to them with $\frac{n}{1000} \cdot \varphi_{20}$. Choose the intersection points of one of the short sides of the rectangle with the lines n, $\frac{n}{1000} \cdot \varphi_{20}$ and S as zero-points for scales, that are to be plotted on the three lines. Derive the figures x_n from column 2 in table 5 and plot on the line marked n divisions with distances x_n cm from the zero-point. Mark in a suitable way the divisions with the numbers n in column 1 in table 5. Construct in similar way scales for $\frac{n}{1000} \cdot \varphi_{20}$ and S by means of the figures in the columns 3, 4, 5 and 6 in table 5. The nomogram then will be ready for use.

It may be used for computing the product $\frac{n}{1000} \cdot \varphi_{20}$, where n is an arbitrary number and where φ_{20} applies to a water sample with the salinity S. The proceeding is the following: Mark on the n-scale and the S-scale points indicating the value of n and S in question. Draw a straight line through these points. Read off the value that on the $\frac{n}{1000} \cdot \varphi_{20}$-scale is indicated by the intersection point between the drawn line and the $\frac{n}{1000} \cdot \varphi_{20}$-scale. This value is equal to the required value of $\frac{n}{1000} \cdot \varphi_{20}$. For practical work a piece of transparent celluloid or transparent paper with a straight line of a length ca. 40 cm. may be recommended.

In connection with table 4 the nomogram may also be used for computing the product $\frac{n}{1000} \cdot \varphi_t$, where n is an arbitrary number and where φ_t applies to a water sample with the salinity S. The proceeding is then the following:

Take from table 4 the value of $S' - S$ for the salinity S and the temperature t. Compute the

salinity S' by adding the difference $S' - S$ to S. Draw a straight line through the points that indicate the values of n and S' on the n-scale and the S-scale in the nomogram. The value of $\frac{n}{1000} \cdot \varphi_t$ is then indicated at the intersection point of the drawn line and the $\frac{n}{1000} \cdot \varphi_{20}$-scale in the nomogram.

The just mentioned nomogram for computing Q_{kg} when $Q_{L_{20}}$ is known may be designated as nomogram: $(Q_{L_{20}} \rightarrow Q_{kg})$. The construction of a nomogram: $(Q_{kg} \rightarrow Q_{L_{20}})$ for computing $Q_{L_{20}}$ when Q_{kg} is known may be performed in a similar way. The difference between the two nomograms consists in the marking and divisions of the scales only.

The scale marked n is the same in both nomograms.

The scale marked $\frac{n}{1000} \cdot \varphi_{20}$ in the nomogram: $(Q_{L_{20}} \rightarrow Q_{kg})$ is to be replaced in the nomogram: $(Q_{kg} \rightarrow Q_{L_{20}})$ by a scale marked $\frac{n}{1000} \cdot \sigma_{20}$ with divisions constructed by means of the figures in the columns 7 and 8 in table 5.

The scale marked S in the nomogram: $(Q_{L_{20}} \rightarrow Q_{kg})$ is to be replaced in the nomogram: $(Q_{kg} \rightarrow Q_{L_{20}})$ by a scale also marked S but constructed by means of the figures in the columns 9 and 10 in table 5.

When the nomogram: $(Q_{kg} \rightarrow Q_{L_{20}})$ is ready it may be used for computing the product $\frac{n}{1000} \cdot \sigma_{20}$, where n is an arbitrary number and where σ_{20} applies to a water sample with the salinity S. The proceeding for computing the product $\frac{n}{1000} \cdot \sigma_{20}$ by means of the nomogram: $(Q_{kg} \rightarrow Q_{L_{20}})$ is similar to that used for computing the product $\frac{n}{1000} \cdot \varphi_{20}$ by means of the nomogram: $(Q_{L_{20}} \rightarrow Q_{kg})$.

In connection with table 4 the nomogram: $(Q_{kg} \rightarrow Q_{L_{20}})$ may also be used for computing the product $\frac{n}{1000} \cdot \sigma_t$ where n is an arbitrary number and where σ_t applies to a water sample with the salinity S. The proceeding is analogous to that used for computing the product $\frac{n}{1000} \cdot \varphi_t$ by means of table 4 and the nomogram: $(Q_{L_{20}} \rightarrow Q_{kg})$.

D Examples of practical computations.

1) Given: The amount Q_{L_t} of a constituent per litre seawater at $t°$ C.
required: The amount Q_{L_T} of a constituent per litre seawater at $T°$ C.

Formula (3): $Q_{L_T} = Q_{L_t} + Q_{L_t} \cdot \frac{r_T - r_t}{1000}$ may be used.

Example: For a water sample of salinity 35.43 ‰ is found the alkalinity 2.437 milliequivalents per litre seawater at 28°. What is the alkalinity per litre seawater α) at 15° and β) at 20°?

In the case α) we have $S = 35.43$, $T = 15$, $t = 28°$ and $Q_{L_t} = 2.437$. From table 1 we get:

$$r_T = 1.2 \quad \text{and} \quad r_t = -2.3$$

Then we have $\frac{r_T - r_t}{1000} = 0.0035$.

The quantity $Q_{L_t} \cdot \frac{r_T - r_t}{1000}$ may with sufficient accuracy be put equal to 2.44×0.0035 and may be computed by a table for multiplication or by a slide rule.

We get:

$$Q_{L_t} \cdot \frac{r_T - r_t}{1000} = 0.009$$

and then:

$$Q_{L_T} = 2.437 + 0.009 = 2.446.$$

In the case β) we have $S = 35.43$, $T = 20$, $t = 28$ and $Q_{L_t} = 2.437$.

From table 1 we get:

$$r_T = 0.0 \text{ and } r_t = -2.3.$$

Then $\frac{r_T - r_t}{1000} = 0.0023$, $Q_{L_t} \cdot \frac{r_T - r_t}{1000} = 0.006$ and $Q_{L_T} = 2.443$.

2) Given: The amount Q_{L_t} of a constituent per litre seawater at $t°$ C.
required: The amount Q_{kg} of a constituent per kilo.

For computation of Q_{kg} the formula (5):

$$Q_{kg} = Q_{L_t} + Q_{L_t} \cdot \frac{\varphi_{20} - r_t}{1000} \text{ may be used.}$$

Example: For seawater of salinity 35.23 ‰ is found the content of oxygen 6.43 cm.³ (0°, 760 mm.) per litre seawater at 7°.5. What is the content of oxygen per kilo seawater?

We have $S = 35.23$, $t = 7.5$ and $Q_{L_t} = 6.43$.

From table 1 and 3 we get:

$$r_t = 2.6 \text{ and } \varphi_{20} = -24.4.$$

Then $\frac{\varphi_{20} - r_t}{1000} = -0.0270$.

We get:

$$Q_{L_t} \cdot \frac{\varphi_{20} - r_t}{1000} = -6.43 \times 0.027 = -0.17$$

and $Q_{kg} = 6.43 - 0.17 = 6.26$.

For computation of Q_{kg} also the formula (6):

$Q_{kg} = Q_{L_t} + Q_{L_t} \cdot \frac{\varphi_{20,\,S'}}{1000}$ may be used.

For the example above we have:

$S = 35.23$, $t = 7.5$ and $Q_{L_t} = 6.43$.

By means of table 4 we get: $S' - S = 3.4$
and then we have $S' = 35.23 + 3.4 = 38.6$.
By means of table 3 we get:

$$\frac{\varphi_{20,\,S'}}{1000} = -0.0268.$$

Then we have $Q_{kg} = 6.43 - 6.43 \times 0.0268 = 6.26$.

For computation of Q_{kg} also the nomogram: $(Q_{L_{20}} \rightarrow Q_{kg})$ may be used.

First the salinity $S' = 38.6$ is to be found by means of table 4 as above.

A straight line through the point $n = 643$ on the n-scale and the point $S' = 38.6$ on the S-scale intersects with the $\frac{n}{1000}\varphi_{20}$-scale in the point $\frac{n}{1000} \cdot \varphi_{20} = -17$.

Then we have $\frac{6.43}{1000}\varphi_{20,\,S'} = -0.17$
and $Q_{kg} = 6.43 - 0.17 = 6.26$.

3) Given: The amount Q_{kg} of a constituent per kilo seawater.
required: The amount Q_{L_t} of a constituent per litre seawater at $t°$.

For computation of Q_{L_t} the formula (8):

$$Q_{L_t} = Q_{kg} + Q_{kg}\frac{\sigma_{20} + r_t}{1000}$$ may be used.

Example: For seawater of salinity 35.23 ‰ the content of oxygen is known to be 6.26 cm³ (0°, 760 mm) per kilo seawater. What is the content of oxygen per litre seawater at 7°.5? — i. e. the inverse computation of that in the above example.

We have: $S = 35.23$, $t = 7.5$ and $Q_{kg} = 6.26$.

From table 1 and 2 we get:

$$r_t = 2.6 \text{ and } \sigma_{20} = 25.0$$

then $\frac{\sigma_{20} + r_t}{1000} = 0.0276$.
We get:

$$Q_{kg} \cdot \frac{\sigma_{20} + r_t}{1000} = 6.26 \times 0.0276 = 0.17$$

and $Q_{L_t} = 6.26 + 0.17 = 6.43$.

For computation of Q_{L_t} also the formula (9):

$$Q_{L_t} = Q_{kg} + Q_{kg} \cdot \frac{\sigma_{20,\,S'}}{1000}$$ may be used.

For the example above we have:

$S = 35.23$, $t = 7.5$ and $Q_{kg} = 6.26$.

By means of table 4 we get $S' - S = 3.4$
and then we have $S' = 35.23 + 3.4 = 38.6$.
By means of table 2 we get:

$$\frac{\sigma_{20,\,S'}}{1000} = 0.0275.$$

Then we have:

$$Q_{L_t} = 6.26 + 6.26 \times 0.0275 = 6.43.$$

For computation of Q_{L_t} also the nomogram $(Q_{kg} \rightarrow Q_{L_t})$ may be used.

First the salinity $S' = 38.6$ is to be found by means of table 4 as above.

A straight line through the point $n = 626$ on the n-scale and the point $S' = 38.6$ on the S-scale intersects with the $\frac{n}{1000} \cdot \sigma_{20}$-scale in the point $\frac{n}{1000} \cdot \sigma_{20} = 17$.

Then we have: $\frac{6.26}{1000} \cdot \sigma_{20,\,S'} = 0.017$
and $Q_{L_t} = 6.26 + 0.17 = 6.43$.

II. Significations and units for indication of the different constituents of the seawater relative to the amount of seawater adopted for common use.

All indications of the amounts of constituents in seawater are to be referred to seawater without any suspended matter.

The atomic weights stated below are the international atomic weights of 1932 with $O = 16.000$.

Chlorinity — Designation: Cl ‰.

The chlorinity means the amount in grams of chlorions that would be contained in 1 kg seawater when the ions of bromine and iodine have been replaced by their equivalent amount of chlorions.

The determination of the chlorinity is to be made on the basis of "standard water" of known chlorinity. If the determination is made by means of a volumetric titration the tables of M. Knudsen may be used for a direct computation of the chlorinity. Atomic weight: $Cl = 35.457$.

Salinity — Designation: S ‰.

The salinity S ‰ is defined by the chlorinity Cl ‰ by the formula $S = 0.030 + 1.8050\ Cl$ (Knudsen's tables).

Remark: The salinity as defined above means the content of "oceanic salts" only.

Content of Sulphate — Designation: SO_4 ‰.

The content of sulphate means the amount in grams of SO_4''-ions contained in 1 kg. of seawater. Atomic weights: $S = 32.06$; $O = 16.000$.

Content of Borate — Designation: BO_3 ‰.
The content of borate means the amount in grams of BO_3'''-ions that is equivalent to the amount of borates contained in 1 kg. of seawater.
Atomic weights: $B = 10.82$; $O = 16.000$.

Content of Magnesium — Designation: Mg ‰.
The content of magnesium means the amount in grams of $Mg^{\cdot\cdot}$-ions contained in 1 kg. of seawater.
Atomic weight: $Mg = 24.32$.

Content of Calcium — Designation: Ca ‰.
The content of calcium means the amount in grams of $Ca^{\cdot\cdot}$-ions contained in 1 kg. of seawater.
Atomic weight: $Ca = 40.07$.

Titration Alkalinity — Designation: Alk.; Unit: $\frac{\text{milliequivalent}}{\text{kg.}}$.
The titration alkalinity means the amount of base, expressed in milliequivalents, that in 1 kg. of seawater is bound to "weak acids". The uncertainty of the expression "weak acids" involves, that the method used by the determination of the alkalinity is to be stated exactly, when results are published.
The method of expelling the total carbon dioxide of seawater by hydrochloric acid and titration of the surplus of acid by sodiumhydroxide with brom-cresol-green as indicator may be used.

Content of oxygen — Designation: O_2; Unit: $\frac{ml}{l}$.
The content of oxygen means the number of ml gaseous oxygen, measured at 0° and 760 mm. Hg (0°, 45° N. L.), contained in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $O = 16.000$.
Volume of 1 gram molecule oxygen at 0°, 760 mm. Hg (0°, 45° N. L.): 22.393 litre.

Content of Hydrogen Sulphide — Designation: H_2S; Unit: $\frac{ml}{l}$.
The content of hydrogen sulphide means the number of ml gaseous hydrogen sulphide, measured at 0° and 760 mm. Hg (0°, 45° N. L.), equivalent to the amount of free hydrogen sulphide, sulphides and bisulphides contained in an amount of seawater that at 20° has the volume 1 litre.
Atomic weights: $H = 1.008$, $S = 32.06$.
Volume of 1 gram molecule hydrogen sulphide at 0°, 760 mm. Hg (0°, 45° N. L.) = 22.14 litre.

Content of Free Nitrogen — Designation: N_2; Unit: $\frac{ml}{l}$.
The content of free nitrogen means the number of ml gaseous nitrogen, measured at 0°, 760 mm. Hg (0°, 45° N. L.) contained in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $N = 14.008$.
Volume of 1 gram molecule nitrogen at 0°, 760 mm. Hg (0°, 45° N. L.) = 22.401 litre.
Remark When the total amount of the free nitrogen and the inactive gases is determined by volume analysis and no destinction is made between the nitrogen and the inactive gases the result is to be designated as "Contents of free nitrogen and inactive gases".

Total content of Carbon dioxide — Designation: Total CO_2; Unit: $\frac{ml}{l}$.
The total content of carbon dioxide means the number of ml gaseous carbon dioxide, measured at 0° and 760 mm. Hg (0°, 45° N. L.), equivalent to the amount of gaseous carbon dioxide, carbonates and bicarbonates contained in an amount of seawater that at 20° has the volume 1 litre.
Atomic weights: $C = 12.00$, $O = 16.000$.
Volume of 1 gram molecule carbon dioxide at 0°, 760 mm. Hg (0°, 45° N. L.) = 22.260 litre.

Content of Free Carbon dioxide — Designation: Free CO_2; Unit: $\frac{ml}{l}$.
The content of free carbon dioxide means the total content of carbon dioxide minus the number of ml gaseous carbon dioxide, measured at 0° and 760 mm. Hg (0°, 45° N. L.), equivalent to the amount of carbonates and bicarbonates contained in an amount of seawater that at 20° has the volume 1 litre.
Atomic weights: $C = 12.00$, $O = 16.000$.
Volume of 1 gram molecule carbon dioxide at 0° and 760 mm Hg (0°, 45° N. L.) = 22.260 litre.

Pressure of Carbon dioxide — Designation: P_{CO_2} Unit: 10^{-4} Atm.

Hydrogen ion concentration — Designation: pH_t.
The hydrogen ion concentration of seawater at a temperature t is termed pH_t when the determination has been made on a basis of the conventional constants of S. P. L. Sørensen. For the activity of the hydrogen ions the designation paH_t may be used. (see K. Buch: Ueber das Kohlensäuresystem im Meerwasser, Rapp. et Proc. Verb. Vol. 79, p. 20). In publishing results it is to be stated if corrections are added for salt error and temperature effects and, if so, what corrections are used.

Content of Phosphate — Designation: Phosphate-P, Unit: $\frac{\mu g\text{-atom}}{l}$.
The content of phosphate means the number of μg-atoms of phosphorus contained in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $P = 31.02$.

Remark: The proceeding in estimating the content of phosphate — including the correction, if any, used for salt error — is to be stated in connection with the results.

Content of Dissolved Organic Compounds of Phosphorus — Designation: Dissolved organic-P, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of dissolved organic compounds of phosphorus means the number of μg-atoms of phosphorus contained as dissolved organic compounds of phosphorus in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $P = 31.02$.
Remark: The number of μg-atoms phosphorus contained in the plankton in an amount of seawater that at 20° has the volume 1 litre is to be designated as "contents of plankton phosphorus" (Plankton-P). The total number of μg-atoms phosphorus contained in an amount of seawater that at 20° has the volume 1 litre and has not been freed from plankton is to be designated by: Phosphate-P + Dissolved organic P + Plankton-P.

Content of Nitrate — Designation: Nitrate-N, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of nitrate means the number of μg-atoms of nitrogen contained as nitrate in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $N = 14.008$.

Content of Nitrite — Designation: Nitrite-N, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of nitrite means the number of μg-atoms of nitrogen contained as nitrite in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $N = 14.008$.

Content of Ammonia — Designation: Ammonia-N, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of ammonia means the number of μg-atoms of nitrogen contained in ammonia in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $N = 14.008$.

Content of Albuminoid Nitrogen — Designation: Albuminoid-N, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of albuminoid nitrogen means the number of μg-atoms of nitrogen contained in albuminoid compounds in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $N = 14.008$.

Content of Organic Nitrogen — Designation: Organic-N, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of organic nitrogen means the number of μg atoms of nitrogen contained in organic compounds in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $N = 14.008$.

Table 1.

$$r_t = \left(\frac{1 + \frac{\sigma_t}{1000}}{1 + \frac{\sigma_{20}}{1000}} - 1 \right) \times 10^3$$

t°C \ S ‰	5	10	15	20	25	30	35	40
0	1.9	2.1	2.4	2.6	2.8	3.1	3.3	3.5
1	1.9	2.2	2.4	2.6	2.8	3.0	3.2	3.4
2	2.0	2.2	2.4	2.6	2.8	3.0	3.1	3.3
3	2.0	2.2	2.4	2.5	2.7	2.9	3.0	3.2
4	2.0	2.1	2.3	2.5	2.6	2.8	3.0	3.1
5	1.9	2.1	2.3	2.4	2.6	2.7	2.8	3.0
6	1.9	2.0	2.2	2.3	2.5	2.6	2.7	2.9
7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.7
8	1.8	1.9	2.0	2.1	2.2	2.3	2.5	2.6
9	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
10	1.6	1.7	1.8	1.9	2.0	2.1	2.1	2.2
11	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.0
12	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.8
13	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.6
14	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4
15	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2
16	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0
17	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8
18	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
19	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	—0.2	—0.2	—0.2	—0.2	—0.2	—0.3	—0.3	—0.3
22	—0.5	—0.5	—0.5	—0.5	—0.5	—0.5	—0.5	—0.5
23	—0.7	—0.7	—0.7	—0.8	—0.8	—0.8	—0.8	—0.8
24	—0.9	—1.0	—1.0	—1.0	—1.0	—1.1	—1.1	—1.1
25	—1.2	—1.2	—1.3	—1.3	—1.3	—1.4	—1.4	—1.4
26	—1.5	—1.5	—1.5	—1.6	—1.6	—1.7	—1.7	—1.7
27	—1.7	—1.8	—1.8	—1.9	—1.9	—2.0	—2.0	—2.0
28	—2.0	—2.1	—2.1	—2.2	—2.2	—2.3	—2.3	—2.3
29	—2.3	—2.4	—2.4	—2.5	—2.5	—2.6	—2.6	—2.7
30	—2.6	—2.7	—2.8	—2.8	—2.9	—2.9	—3.0	—3.0

ontent of Silicate — Designation: Silicate-*Si*, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of silicate means the number of g-atoms of silicon contained as silicates in an amount f seawater that at 20° has the volume 1 litre. tomic weight: *Si* = *28.06*.

ontent of Arsenate — Designation: Arsenate-*As*, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of arsenate means the number of g-atoms of arsenic contained as arsenates in an mount of seawater that at 20° has the volume 1 litre. tomic weight: *As* = *74.93*.

Content of Arsenite — Designation: Arsenite-*As*, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of arsenite means the number of μg-atoms of arsenic contained as arsenite in an amount of seawater that at 20° has the volume 1 litre. Atomic weight: *As* = *74.93*.

Content of Iron — Designation: *Fe*, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of iron means the number of μg-atoms

(continued on page 12).

Table 2.

$\sigma_{20} = (s_{20/_4} - 1) \times 10^3$

‰	0	10	20	30	40
0		5.9	13.4	21.0	28.6
1		6.6	14.2	21.7	29.4
2	—0.2	7.4	14.9	22.5	30.1
3	0.5	8.1	15.7	23.3	30.9
4	1.3	8.9	16.4	24.0	31.7
5	2.1	9.6	17.2	24.8	32.4
6	2.8	10.4	18.0	25.5	
7	3.6	11.1	18.7	26.3	
8	4.3	11.9	19.5	27.1	
9	5.1	12.7	20.2	27.8	
0	5.9	13.4	21.0	28.6	

Table 3.

$\varphi_{20} = \left(\frac{1}{1 + \frac{\sigma_{20}}{1000}} - 1\right) \times 10^3$

‰	0	10	20	30	40
0		— 5.8	—13.2	—20.6	—27.8
1		— 6.6	—14.0	—21.3	—28.5
2	0.2	— 7.3	—14.7	—22.0	—29.2
3	—0.5	— 8.1	—15.4	—22.7	—30.0
4	—1.3	— 8.8	—16.2	—23.5	—30.7
5	—2.1	— 9.5	—16.9	—24.2	—31.4
6	—2.8	—10.3	—17.6	—24.9	
7	—3.6	—11.0	—18.4	—25.6	
8	—4.3	—11.8	—19.1	—26.4	
9	—5.1	—12.5	—19.8	—27.1	
0	—5.8	—13.2	—20.6	—27.8	

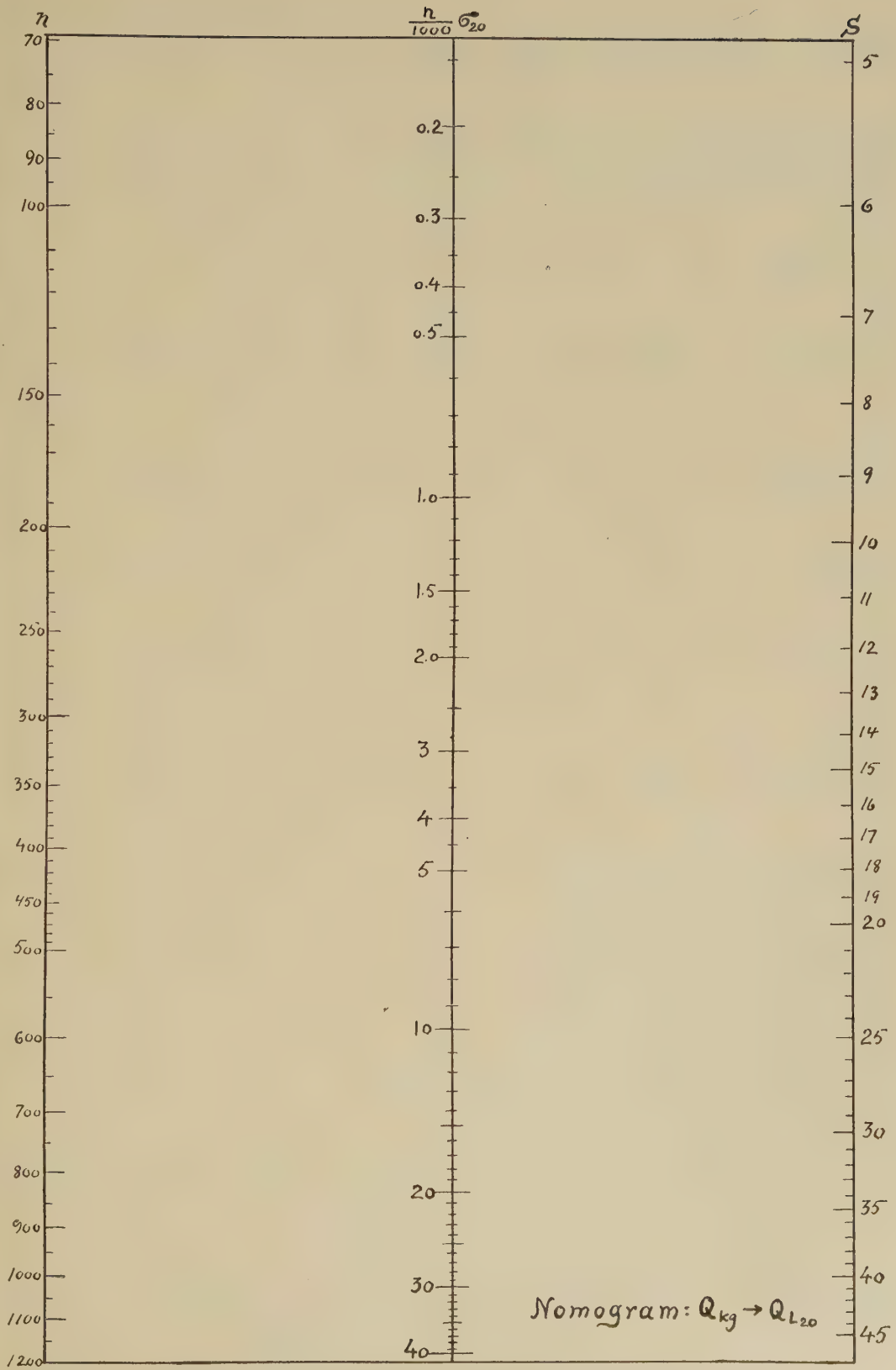
D = *0.7*		*D* = *0.8*
—0.07	0.0	—0.06
0.07		0.06
	0.1	
0.21		0.19
	0.2	
0.36		0.31
	0.3	
0.50		0.44
	0.4	
0.64		0.56
	0.5	
0.79		0.69
	0.6	
0.93		0.81
	0.7	
1.07		0.94
	0.8	
		1.06

Table 4.

The Difference $S' - S$ when $\varphi_{t,S} = \varphi_{20,S'}$ and $\sigma_{t,S} = \sigma_{20,S'}$

t°C \ S ‰	5	10	15	20	25	30	35	40
0	2.5	2.9	3.2	3.5	3.8	4.1	4.4	4.7
1	2.6	2.9	3.2	3.5	3.8	4.0	4.3	4.6
2	2.6	2.9	3.2	3.5	3.7	4.0	4.2	4.4
3	2.6	2.9	3.1	3.4	3.6	3.9	4.1	4.3
4	2.6	2.8	3.1	3.3	3.5	3.8	4.0	4.2
5	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
6	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.8
7	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.6
8	2.3	2.5	2.7	2.9	3.0	3.2	3.3	3.4
9	2.2	2.4	2.5	2.7	2.8	3.0	3.1	3.2
10	2.1	2.3	2.4	2.5	2.6	2.8	2.9	3.0
11	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
12	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
13	1.6	1.7	1.8	1.9	2.0	2.1	2.1	2.2
14	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9
15	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.6
16	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.3
17	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0
18	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7
19	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	—0.3	—0.3	—0.3	—0.3	—0.3	—0.3	—0.4	—0.4
22	—0.6	—0.6	—0.6	—0.7	—0.7	—0.7	—0.7	—0.7
23	—0.9	—0.9	—1.0	— 1.0	—1.0	—1.1	—1.1	—1.1
24	—1.2	—1.3	—1.3	—1.4	—1.4	—1.4	—1.5	—1.5
25	—1.6	—1.6	—1.7	—1.7	—1.8	—1.8	—1.9	—1.9
26	—1.9	—2.0	—2.1	—2.1	—2.2	—2.2	—2.3	—2.3
27	—2.3	—2.4	—2.4	—2.5	—2.6	—2.6	—2.7	—2.7
28	—2.7	—2.8	—2.8	—2.9	—3.0	—3.1	—3.1	—3.2
29	—3.1	—3.2	—3.3	—3.3	—3.4	—3.5	—3.5	—3.6
30	—3.5	—3.6	—3.7	—3.8	—3.9	—3.9	—4.0	—4.0

Nomogram for calculating Q_{kg} from $Q_{L_{20}}$. In connection with table 4 the nomogram may also be used for computing Q_{kg} when Q_{Lt} is known.



Nomogram for calculating $Q_{L_{20}}$ from Q_{kg}. In connection with table 4 the nomogram may also be used for computing Q_{L_t} when Q_{kg} is known.

Table 5.

1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
n	x_n	n	x_n	n	x_n	n	x_n	n	x_n	n	x_n	n	x_n	n	x_n	n	x_n
70	0.13	110	5.04	180	10.38	250	13.95	320	16.63	390	18.78	460	20.57	650	24.32	1000	29.00
75	0.88	120	5.98	190	10.97	260	14.37	330	16.96	400	19.05	470	20.80	700	25.13	1050	29.53
80	1.58	130	6.85	200	11.53	270	14.78	340	17.29	410	19.32	480	21.03	750	25.88	1100	30.04
85	2.24	140	7.65	210	12.06	280	15.18	350	17.60	420	19.58	490	21.26	800	26.58	1150	30.52
90	2.86	150	8.40	220	12.56	290	15.56	360	17.91	430	19.84	500	21.47	850	27.24	1200	30.98
95	3.44	160	9.10	230	13.04	300	15.93	370	18.20	440	20.09	550	22.51	900	27.86		
100	4.00	170	9.76	240	13.50	310	16.28	380	18.49	450	20.33	600	23.45	950	28.44		

3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4
$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$	$\frac{n}{1000}\varphi_{20}$	$x_{\frac{n}{1000}\varphi_{20}}$
—0.15	0.65	—0.5	7.19	—1.2	11.94	—1.9	14.43	— 5	19.69	—12	24.44	—19	26.93	- 26	28.64	—33	29.93
—0.20	2.21	—0.6	8.18	—1.3	12.37	—2.0	14.71	— 6	20.68	—13	24.87	—20	27.21	—27	28.84	—34	30.09
—0.25	3.42	—0.7	9.01	—1.4	12.78	—2.5	15.92	— 7	21.51	—14	25.28	—21	27.48	—28	29.04	—35	30.25
—0.30	4.41	—0.8	9.74	—1.5	13.15	—3.0	16.91	— 8	22.24	—15	25.65	—22	27.73	—29	29.23	—36	30.40
—0.35	5.25	—0.9	10.38	—1.6	13.50	—3.5	17.75	— 9	22.88	—16	26.00	—23	27.97	—30	29.41	—37	30.55
—0.40	5.98	—1.0	10.95	—1.7	13.83	—4.0	18.48	—10	23.45	—17	26.33	—24	28.20	—31	29.59	—38	30.70
—0.45	6.61	—1.1	11.47	—1.8	14.14	—4.5	19.11	—11	23.97	—18	26.64	—25	28.42	—32	29.76	—39	30.84
																—40	30.98

5	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6
S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S
5	0.77	10	12.03	14	16.52	19	20.32	23	22.62	28	24.92	32	26.46	37	28.12	41	29.28
6	4.15	11	13.34	15	17.40	20	20.94	24	23.12	29	25.33	33	26.82	38	28.42	42	29.55
7	6.72	12	14.50	16	18.21	21	21.53	25	23.60	30	25.72	34	27.16	39	28.71	43	29.82
8	8.79	13	15.56	17	18.96	22	22.09	26	24.06	31	26.10	35	27.49	40	29.00	44	30.07
9	10.53			18	19.66			27	24.50			36	27.81			45	30.32

7	8	7	8	7	8	7	8	7	8	7	8	7	8	7	8	7	8
$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$	$\frac{n}{1000}\sigma_{20}$	$x_{\frac{n}{1000}\sigma_{20}}$
0.15	0.50	0.5	7.03	1.2	11.79	1.9	14.28	5	19.53	12	24.29	19	26.78	26	28.48	33	29.78
0.20	2.06	0.6	8.02	1.3	12.22	2.0	14.56	6	20.52	13	24.72	20	27.06	27	28.69	34	29.94
0.25	3.27	0.7	8.86	1.4	12.62	2.5	15.77	7	21.36	14	25.12	21	27.32	28	28.89	35	30.10
0.30	4.26	0.8	9.58	1.5	13.00	3.0	16.76	8	22.08	15	25.50	22	27.58	29	29.08	36	30.25
0.35	5.10	0.9	10.22	1.6	13.35	3.5	17.60	9	22.72	16	25.85	23	27.82	30	29.26	37	30.40
0.40	5.82	1.0	10.80	1.7	13.68	4.0	18.32	10	23.30	17	26.18	24	28.05	31	29.44	38	30.54
0.45	6.46	1.1	11.31	1.8	13.99	4.5	18.96	11	23.81	18	26.49	25	28.27	32	29.61	39	30.68
																40	30.82

9	10	9	10	9	10	9	10	9	10	9	10	9	10	9	10	9	10
S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S	S	x_S
5	0.48	10	11.78	14	16.31	19	20.15	23	22.48	28	24.82	32	26.40	37	28.09	41	29.29
6	3.88	11	13.10	15	17.19	20	20.78	24	22.99	29	25.24	33	26.76	38	28.40	42	29.57
7	6.46	12	14.28	16	18.01	21	21.38	25	23.48	30	25.64	34	27.11	39	28.71	43	29.84
8	8.54	13	15.24	17	18.77	22	21.94	26	23.95	31	26.02	35	27.45	40	29.00	44	30.10

iron contained as $Fe^{\cdot\cdot}$ and $Fe^{\cdot\cdot\cdot}$ ions in an amount seawater that at 20° has the volume 1 litre.
omic weight: $Fe = 55.84$.

ontent of Manganese — Designation: Mn, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of manganese means the number of -atoms of manganese contained as $Mn^{\cdot\cdot}$ and $Mn^{\cdot\cdot\cdot}$ ions in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $Mn = 54.93$.

Content of Copper — Designation: Cu, Unit: $\frac{\mu g\text{-atom}}{l}$.

The content of copper means the number of μg-atoms of copper contained as $Cu^{\cdot\cdot}$-ions in an amount of seawater that at 20° has the volume 1 litre.
Atomic weight: $Cu = 63.57$.

PLANKTON COMMITTEE

1935.

Prof. H. H. Gran.

Belgium.

No report received.

Denmark.

By Prof. Ove Paulsen.

The work carried out in 1935 by the Plankton Laboratory of "Kommissionen for Danmarks Fiskeri- og Havundersøgelser" may be recorded as follows:

I. Home waters.

1. At the initiative of the Danish Biological Station an investigation on the herring food in the Bornholm waters was commenced in 1932; this work has been continued throughout 1935 by Dr. Jespersen. The collection of samples was discontinued at the end of 1935. During $3^1/_2$ years the stomach contents of some 5,000 Bornholm herring, collected at all seasons, have been analyzed and the examination of the material is that far advanced that a report is expected to be ready for publication at an early date (1).

2. Weekly collections of plankton from three lightships in Danish waters have been continued.

3. On each of the routes: Oslo—Copenhagen, Odense—Copenhagen, and Rønne (Bornholm)—Copenhagen, three water samples have been collected every fortnight; these samples are preserved, partly for quantitative plankton determinations, partly used for phosphate determinations as also salinities have been determined by the Hydrographical Laboratory. The object of the programme is to investigate the development of production in Danish waters at different seasons.

4. The working up of the material of the investigations 1932—33 concerning the plankton production in the Sound has been continued.

II. Northern waters.

1. The examination of zoo- and phytoplankton from Iceland waters and from the Denmark Strait has been continued; the large material of zooplankton from the "Dana"-cruises, 1924—34, in those waters is approaching completion and a comparative arrangement of results may be commenced in the near future.

2. An examination of the copepod-fauna of East Greenland fjords, based on samples collected during 1932 and 1933, has been continued.

3. The quantitative examination of the phytoplankton material from the Faroes, Iceland and East Greenland has been finished and a report has been published (2).

4. During the cruise of the M/C "Thor" to South and West Iceland, May and June 1935, a series of macroplankton samples were collected by Dr. Steemann Nielsen by means of a special quantitative gear constructed by him. The samples have been counted and the practicability of the instrument has been proved. A paper on this method has been published in the *Journal du Conseil* (3).

5. During a cruise of the M/C "Thor" to the south and west coast of Iceland, May and June, the penetration of light was measured at different depths by means of an instrument into which photo-cells were built, each with a special colour-filtre. Simultaneously, "change of matter" determinations were made with regard to phytoplankton for the purpose of showing the influence of light on the CO_2-assimilation, partly at prolonged exposition to a permanent light-intensity, partly under normal conditions.

III. Publications.

1. Jespersen, P., "Undersøgelser over Aarsagen til Svingningerne i Sildefiskeriets Udbytte". Dansk Fiskeritidende. 1935.
2. Nielsen, E. Steemann, "The Production of Phytoplankton at the Faroe Isles, Iceland, East Greenland and in the Waters around". Medd. Komm. Danmarks Fiskeri- og Havunders. Serie Plankton, Vol. III, No. 1. 1935.
3. — "Eine Methode zur exakten quantitativen Bestimmung von Zooplankton". Journal du Conseil, Vol. X. 1935.

France.

No report received.

England.

owestoft.

The plankton investigations carried out by the owestoft Laboratory during 1935 were similar in ope to those of 1934. Nine cruises of the Research teamer "George Bligh", and seven cruises of the lotor Drifter "Onaway" were devoted exclusively to lankton work, as follows:—

1. Investigations on the ether-soluble matter of ried plankton; (a) along the English east coast area June and October); (b) monthly observations at six ations between Flamborough Head and the south-est patch of the Dogger Bank (January—December).

2. Plankton of the northern grounds: four parallel nes of stations across the North Sea, the northern-ost line crossing from off the Northumberland coast off the Naze (May).

3. Investigations into the relation between abund-nce of plankton and hydrological conditions (April, ugust).

4. The relation between phytoplankton concen-rations and the autumn shoaling of herring off East nglia (October and November).

Ether-soluble matter estimates of the Hensen net atches were continued in 1935, the area investigated eing the same as in previous years. The cruise off he English east coast in June revealed values lower n the north and higher in the south than those shown n the previous years of this investigation. For the October cruise in the same area the reverse of this ondition was found.

For the Flamborough Line area the spring fat aximum was lower and occurred later than in 1934, hough as in previous years it began off-shore and pread inshore. In 1935 the inshore spread of an utumn maximum was not apparent. While the lower aximum fat values of 1935 are attributable to the pring diatom maximum the fat content of the zoo-lankton samples appears to have been higher than n 1934.

Measurements of length and determination of the ercentage feeding from various stages of *Calanus nmarchicus*, *Sagitta setosa*, and *S. elegans*, have been ontinued and the percentage feeding from *Pseudo-lanus elongatus* and *Paracalanus parvus* has been btained. This work has revealed interesting appetite ifferences particularly in regard to age.

Phosphate and phytoplankton research was con-nued, with special reference to technique. One result as been the design of a photometer, made in the owestoft Laboratory, which uses a photo-electric el and gives results precise to 1 mg. This has been und convenient and practical for use at sea in rdinary bad weather, and needs no practise nor ersonal colour sense. The first model was, however, ot quite free from occasional lapses of accuracy and inor changes are being made for a full season's test. n the meanwhile some observations were made during he year, as part of a long period programme.

During October and November four successive ruises were made for the purpose of charting concentrations of phytoplankton in the southern North Sea. In early October, dense patches of the two diatoms *Rhizosolenia styliformis* and *Biddulphia sinensis* were found. The *Rhizosolenia* patch extended from the south-west spit of the Dogger Bank to the Leman Bank, while the patch of *Biddulphia* was east of the *Rhizosolenia* concentration, overlapping it to some extent. Herring drifters were working along the western edge of the former patch. In the second half of October *Rhizosolenia* had apparently drifted east, while *Biddulphia* had drifted east and south-east; both patches having decreased in density. In early November there was a further eastward drift of both species and a considerable diminution in density; there was a still further decrease in numbers in late November.

Apart from a short period in the early part of the herring fishing season, the phytoplankton patches were never in positions where they could interfere with the shoaling of herring to any appreciable extent. The fishing ground in the Smith's Knoll area was clear of diatoms throughout the season.

A report on the phytoplankton investigations of 1933 and 1934 has been prepared and is now in the press[1]). A report on the variation in the size of diatoms has been prepared by Mr. Wimpenny and will be published shortly.

Plymouth.

The survey of plant and animal plankton per cubic metre of sea, made throughout 1934 at a position 5 miles off shore, was continued until after the spring diatom outburst in 1935.

Arising from this survey, Dr. Cooper has made experiments to investigate what becomes of the phosphorus utilised by diatoms during the early part of the year and not appearing in the summer plankton fauna. Mr. Harvey has made experiments on the possible choice of diatoms by the copepod *Calanus finmarchicus* when fed for a week on one species and then transferred to water containing the same and another species. The feeding rate was obtained for the particular concentrations of diatoms employed.

Mr. Russell has continued his observations on the occurrence of the two species of Sagitta, *S. elegans* and *S. setosa*, off Plymouth. Throughout this year *S. setosa* has still been the predominant species. The real significance of these changes in the Sagitta population has now been brought to light. The examination of a large number of samples taken off the mouth of the English Channel and south of Ireland, kindly supplied by Mr. G. P. Farran, established that *S. setosa* is absent from that area, but *S. elegans* abundant. At the same time there was found to be a certain correlation between the occurrence or absence of *S. elegans* off Plymouth and the direction of flow of water through the Dover Straits

[1]) Savage, R. E. and Wimpenny, R. S., "Phytoplankton and the Herring — Part II, 1933—1934." Ministry of Agriculture and Fisheries, Fish. Invest. Series II. (In the press).

as shown by Dr. J. N. Carruthers' drift indicator. It was evident that the two Sagitta species were indicators of different water masses and by examination of the plankton data collected over the past five years it was possible to associate certain other plankton animals as indicators with *S. elegans*. The conclusions and hypothetical deductions arising from this work were published in Vol. XX, No. 2, of the Journal of the Marine Biological Association. It was suggested that *S. elegans* would be found to be contained in the water mass previously shown by hydrographers to be in cyclonic circulation off the mouth of the Channel, while *S. setosa* was an indicator of Channel water. To test this suggestion a cruise off the mouth of the Channel was necessary and this became possible in July through the kindness of Col. E. T. Peel, who put his yacht "St. George" at Mr. Russell's disposal. The water mass containing *S. elegans* and its associated species was found to be clearly indicated, and by examination of the plankton content it was possible also to distinguish a body of water entering the Channel past Ushant. The full results of the collection from 28 stations are now ready for publication.

The clearing up of this problem has thrown light on certain other changes off Plymouth. For instance, in recent years there has been a decline in the winter phosphate content of the water. It now appears that the low phosphate values are probably a characteristic of Channel water and as a result the plankton production is limited. The plankton is much richer in *S. elegans* water. It seems possible that the phosphate in Channel water will continue to remain low or decrease until renewed by an invasion of *S. elegans* water such as occurred in 1930 and 1931.

Investigation concerning the Plymouth medusae; free swimming gasteropod larvae, the trematode *Hemiurus communis*, larval crustacea; and the embryology of polychaetes have been made by Mr. F. S. Russell, Dr. M. V. Lebour and Mr. D. P. Wilson respectively.

Germany.

Hamburg.

The hydro-biological department of the "Zoologisches Staatsinstitut" in Hamburg carried out plankton investigations in Icelandic and Faroese waters, and this work has been more fully reported in the report of the North-Western Area Committee. Of greatest importance was considered the collection of such numbers of small and frequent, in time as well as distance, samples of mikroplankton as would permit an exact quantitative representation of the distribution in the surface of this plankton. Small sieves of phosphor-bronze gauze in celluloid frames were used and, as necessity demanded, 5 to 25 l. of water, by certain winter-investigations as much as 50 l., was filtered. Further, dip-samples were collected to determine the loose in using sieve-filtering. A paper by E. Hentschel "Über das Winterplankton im Süden von Island" has been published (Rapp. et Proc.-Verb., Vol. XCIX, III). The examination of the stomach content of cod at the Westmann islands (ibid. II) also was made for plankton purposes, the primary object being to determine how far plankton might be considered a "prime food" for cod.

The Iceland investigations also had the object to test certain simplifications of plankton methods on which work has been carried out elsewhere.

The general part on biology of the investigations of the "Meteor" expedition, which should also be of interest to the International Council, has been finished and is in the press. Papers on Siphonophores (Leloup) and Hydromedusae (Thiel) have been published. For 1936, a continuation of the Iceland investigations is on the top of the programme.

Heligoland.

The "Biologische Anstalt auf Helgoland" has undertaken the following work: investigation of the surface plankton and makroplankton in close relation to hydrography was continued on all cruises ("Poseidon": Hoofden, January 3rd—23rd, German Bight, March 7th—13th; F.P.V. "Elbe": Doggerbank and Hoofden, September 30th—November 3rd; F.P.V. "Weser": Doggerbank and Hoofden, November 11th—December 11th, 1935).

Further, changes in the plankton distribution round Heligoland were closely studied throughout the year.

Holland.

No report received.

Irish Free State.

Plankton collections by means of vertical hauls were made during the Hydrographic Cruises on the north coast of Ireland in February, 1935, and on the south coast in August, 1935. On the south coast cruise samples for comparison with the vertical hauls were taken with the Hardy Plankton Indicator.

Work on the larvae of the Euphausiidae has been continued by Miss W. E. Frost, who has published papers on the development of *Euphasia krohni* and *Nematoscelis megalops*.

Latvia.

No report received.

Norway.

Dr. Trygve Braarud is working (1) with the phytoplankton of the inner part of the Oslo Fjord as influenced by the sewage from the city, and (2) with pure cultures of plankton diatoms to study their growth in dependence of various life conditions.

Mrs. Karen Gaarder is working with the collections of phytoplankton from the "Michael Sars" Expedition 1910.

During 1935 the following papers have been published:

RYGVE BRAARUD: The Øst Expedition to the Denmark Strait 1929. II. The Phytoplankton and its conditions of growth (including some qualitative data from the Arctic in 1930). Hvalraadets Skrifter, Nr. 10.

. H. GRAN and TRYGVE BRAARUD: A Quantitative Study of the Phytoplankton in the Bay of Fundy and the Gulf of Maine (including Observations on Hydrography, Chemistry and Turbidity). Journal of the Biological Board of Canada, Volume I, No. 5.

Poland.

No report received.

Portugal.

No report received.

Scotland.

A summary of the cruises undertaken by Scotland given in the report of the Northern North Sea ommittee. Observations on phytoplankton and on oplankton were carried out at all stations. The nets constant use were the following:—

Standard for vertical hauls
Hjort - — —
1-metre Ring — for horizontal hauls of 15 minutes
2-metre Ring — vertical hauls.

The investigations were again concentrated on the iology of *Calanus* and on the distribution and relative undance of the pelagic larval stages of the principal od fishes. A report on the Copepod Crustacea is now the press. The Hensen net will be brought into se during 1936 for quantitative hauls. A general report on the herring larvae collected over a long series of years is being prepared for publication.

Special attention is being devoted to the occurrences in the area of pelagic exotic forms, e. g. Salps and Doliolids and their distribution in separate years charted with a view to correlation with variations in the direction and flow of oceanic water. A study is being made of the different species of Sagitta which occur in the area. Investigation into the food of herring is being continued.

Herring larvae at sizes from 11 to 20 mm. occurred sparingly in the catches along the Plateau from the Patch to Viking Bank. At the above positions within the Norwegian Deep larger numbers were obtained, especially at the latter locality where 392 larvae from 11—15 mm. and 116 from 16—20 mm. in length were secured in a horizontal haul of 15 minutes' duration with a metre ring net (cheesecloth material).

Haddock larvae were not observed in the hauls taken within the Norwegian Deep.

Macroplankton was poorly represented in April at the above two stations. *Calanus* was present at the surface and in intermediate layers. Euphausids and Decapod larvae occurred at the surface. A few *Aglantha* and some remains of *Agalmopsis* also made their appearance in the collections.

Spain.

No report received.

Sweden.

See Baltic Area Report.

Note.

The Attention is drawn also to the various Area Reports in which further details are given for some countries.

SALMON AND TROUT COMMITTEE
1935.

Prof. M. Siedlecki.

From the reports of different countries it may be concluded that the year, 1935, may be considered a mediocre salmon year.

The following investigations were made by different countries:

Denmark.

Biological Investigations.

Marking experiments with sea trout have been carried out in water courses in the western part of Jutland, and scales of sea trout and salmon have been collected from various waters.

The collections of statistics as to length and weight of sea trout caught in the river Gudenaa and the Randers Fjord have been continued. A report concerning the results of the previous collections has been published (Erik M. Poulsen: Recent Investigations into the Stock of Salmon and Sea Trout in the River Gudenaa. Report Danish Biol. Stat. XL, 1935).

Investigations in water courses as to the amount of food available, and conditions in general for fry, in order to determine the optimal amount of fry to be liberated, have been continued.

Statistics for the year 1934. (From "Fiskeri-Beretning 1934", Danish Board of Fishery).

Catch in:	Salmon kg.	Trout kg.
North Sea and Skagerak incl. the Fjords	4,600	4,920
Limfjord	0	61,241
Kattegat and the Sound	17,026	23,848
Belt Sea	4,274	13,869
Baltic	58,080	6,719
Total...	83,980	110,597

The catch of salmon (especially in the Bornholm waters) in 1934 has been considerably lower than in 1933, whereas the catch of sea trout has been about the same.

Output of fry (in thousands) of sea trout in water courses leading to the	fry	half-yearlings
North Sea	755	40
Limfjord	844	39
Kattegat	1,064	134
Belt Sea	739	
Western Baltic	113	
Baltic proper	282	
Total...	3,797	213

Of tiny salmon fry 15,000 specimens were liberated in the Kongeaa (West-Jutland). 7.5 Mill. fry of *Coregonus lavaretus* were liberated in water courses leading to the North Sea. The amount of fry liberated almost corresponds to the 1933 number.

Estimation of the yield of the salmon and sea trout fisheries in 1935. No statistics for the year 1935 are as yet available and the following estimates (based on reports from local fishery officials) are therefore very approximate only. The Bornholm salmon fishery (at sea) was carried out with hooks and drift nets in January—March; the yield was apparently below normal; a considerable part of the salmon caught was big salmon. In October—December this fishery was re-commenced; the yield in this period was rather satisfying in respect of the hook-fishery, most of the salmon caught weighing about 4—6 kg. The coastal net fishery in spring for small salmon was of no importance, the stock of small salmon along the coasts being exceedingly small. In the Randers Fjord and the river Gudenaa the catch of sea trout has been about the same as in the previous years; of salmon single specimens only were caught.

England.

Mr. Pryce-Tannatt refers to the official English publication: "Salmon and Freshwater Fisheries Report for the year 1934", issued in 1935, and to that for 1935 at present in preparation for publication during 1936.

Finland.

During 1935 material for scale-analysis of salmon was collected in Tornio, Kemi, Oulu, Kokemäki and Kymi rivers and in the Kemi estuary. Marking of young salmon was carried out in Kokemäki.

The yield of the summer, 1935, amounted to approximately 65 % of that of last year (the exact figures are not yet available).

Fry of salmon was liberated in 1935: in Tornioriver 500,000, in Kemiriver 904,700, in Ouluriver 445,500, in Kokemäkiriver 107,800 and in Kymiriver 133,500; the total number of salmon fry distributed in Baltic waters was 2,091,500. — In the Arctic Paatsjokiriver 51,500 fry of salmon were liberated.

Summer-old parrs were liberated in Kemiriver (26,210 ind.), in Kokemäkiriver (26,000) and in Kymiriver (2,268), a total number of 54,478.

Fry of the chinook-salmon were liberated in Kokemäki and in some of the small rivers in the neighbourhood (16,000). Summer-old parrs of the same fish were liberated in the Kokemäkiriver (56,000), and in the Ouluriver (16,400).

France.

No report received from France.

Germany.

1. **General Report.** (A. Willer).

Salmon. Dr. Bahr has continued his stock-analyses from the sea-fishery station Neukuhren; these investigations have been made regularly since 1928 within the district of the middle Baltic. In 1935/36, 760 specimens of salmon have been subjected to a thorough examination. The report on the result will be combined with the results obtained during the previous three years.

The investigations (commenced in the winter 1934—35) on the food of large line and drift-net salmon have been continued and extended. A total of 140 salmon have been examined. It is already evident that the food of the salmon off the East Prussian coasts changes with the season. In the months of January, February and March *Gasterosteus aculeatus* predominates in the food side by side of *Gammarus locusta, Mysis mixta* and *Mysis vulgaris, Clupea harengus* and *Clupea sprattus*. In spring *Gasterosteus* gives way for *Clupea sprattus* and at the same time *Ammodytes tobianus* are taken in great numbers, whilst earlier they appear exceptionally only. These food investigations will be continued.

As regards the question from which spawning places salmon caught in the mid-Baltic originate it has been necessary to examine and determine the stage of maturity of the gonads of salmon caught. Those examined, however, have just commenced to develop; the testicles were narrow, stock ribbons only the ripening of which would hardly develop during the catch-season, October—March; the ova, on the other hand, though at an early stage of development, showed a definite growth of eggs during this period. It seems that part of the East Prussian catch would have ripened in the following autumn. It will be necessary to examine, systematically, development and maturity of salmon caught along the entire Baltic coast in order to obtain a general view of degrees of maturity of the salmon on its migration along this coast. It should be possible also in this way to extend our knowledge on the salmon spawning places as well as on the question whether and possibly how often it makes the same journey before returning to spawn.

As in previous years young salmon have been marked and liberated in the Baltic, near Neukuhren; most of those marked were Latvian salmon.

The collecting of hooks recovered from the lower jaws of drift-net salmon has been continued; also hooks from the Swedish, Finnish and Latvian coasts have been received.

In addition to the usual East Prussian statistics similar statistics are now being prepared by Dr. Marquard for the Pomeranian coast.

Sea trout. Marking experiments have been carried out on a larger scale with one and two-summer sea trout which were liberated on the Samland coast; sea trout of similar origin and age were marked and kept at the Perteltnicken experimental station in order to determine the difference between growth in the sea and in fresh water, if any. As was the case with salmon, analyses of stock were made, especially of sea trout caught during autumn when re-entering the rivulets of Samland for spawning, and also of sea trout caught by drift-net or hook at sea.

Brown Trout. Comparative examinations of brown trout and sea trout in the sea as well as fresh water have been continued; the results seem to prove absence of any difference in growth. Brown trout were liberated off the Samland coast from the Neukuhren station (Dr. Bahr), from "Deutscher Seefischerei-Verein" (Dr. Fischer), by Dr. Maier, and Dr. Altnöder in the bay of Wismar and on behalf of the "Central-Fischereiverein für Schleswig-Holstein" (Dr. Marre) in the Kiel Bight.

2. Propagation.

The following hatcheries have reared sea trout and partly also salmon for the Baltic:— Alt Müllendorf near Nortorf, Scholderup, and Langballigholz near Langballigau in Schleswig-Holstein, Eldena in Pomerania, and Perteltnicken in East Prussia.

3. Result of Fishery.

The results of the fisheries during the 1934/35 season may be summarized as follows.

Schleswig-Holstein — moderate, somewhat below that of previous years.
Pomerania — in Baltic: poor; in Stettiner Haff: moderate.
East Prussia — poor; far below that of last years.

The cause of the poor salmon fishery in middle Baltic may be due to the unfavourable weather predominating (frequent strong eastern winds).

4. The Salmon Run.

The ascent of salmon has been poor.

Irish Free State.

Biological Investigations.

In 1935 investigations on the food and growth of brown trout and on the age and growth-rate of salmon from the River Shannon were continued.

Artificial Propagation.

During the season 1934—35, 27 hatcheries were operated, 14 of these being stocked with eyed ova distributed from some other hatchery. Ova of salmon

were collected at 10 hatcheries, of sea trout at three hatcheries and of brown trout at 7 hatcheries.

The total number of fry distributed was:

Salmon fry	5,413,000
Sea Trout fry	61,000
Brown Trout fry	1,261,000
Total	6,735,000

This represents a falling off in the total output of about 10 per cent. as compared with the season 1933—34.

The Catch of Salmon 1935.

The complete figures for the catch of salmon in 1935 are not yet available. The weight of salmon exported from the Free State, which usually only differs slightly from the total catch, was 1,238,771 kg., having a value of £196,682. This represents a slight decrease in quantity from the figures of the preceding year.

The quantities exported each month, in kilogrammes, were: January 1,730, February 97,900, March 129,900, April 181,700, May 248,600, June 334,000, July 212,700, August 15,370, September 560. These figures show, as compared with the preceding year, a proportional increase in the catch of spring fish and a falling off in the numbers of grilse.

Latvia.

The Catch of Salmonidae.

The catch of Salmonidae (*S. salar* and *S. trutta*) in the Gulf of Riga and the Baltic proper along the Latvian coasts in the year 1935 amounts to 68,280 kg. only.

This is a decrease of about 40 % on the catch of 1934 (114,310 kg.) and a decrease with regard to the average of salmonidae catch for the 12 years 1924—1935 (90,925 kg.) of about 25 %.

Also the run, and accordingly the catch of salmon and sea trout in the Latvian rivers during the year 1935, was considerably inferior to that of the previous year.

Statistics of Salmonidae fisheries in the year 1935.

Region I. Gulf of Riga		
a. Coast of Vidzeme	5,870 kg.	
b. Riga sea shore..	52,960 -	
c. Coast of Kurzeme	980 -	
Total in the Gulf of Riga...		59,810 kg.
Region II. Kolkasrags		1,965 -
III. Ventspils		1,960 -
IV. Liepaja		1,545 -
Total catch of Salmonidae on the Latvian coast		65,280 kg.

Artificial Propagation.

In the spring of 1935 the following quantities of Salmonidae and Coregonidae hatched in the Government's hatcheries at Tome and Karli were distributed in Latvian waters:

Salmon.	
Daugava	1,025,000
Salace	200,000
Barta	135,000
Total...	1,360,000
Sea Trout.	
Daugava	1,485,000
Gauja	2,095,000
Total...	3,580,000
Lavaret (*Coregonus lavaretus*).	
Gauja	120,000
Salace	500,000
Total...	620,000
Whitefish (*Coregonus generosus*) in various lakes	12,000,000

During the hatching season 1935/1936 the following quantities of fish eggs were collected at the Government's hatcheries for cultivation:

Salmon	1,480,000 eggs
Sea Trout	1,606,000 —
Lavaret	1,150,000 —
Whitefish	19,800,000 —

Biological Investigations.

The Fishery Laboratory of the Ministry of Agriculture continued the collection and the study of the material collected relating to the age distribution and growth-rate of salmon and sea trout from the Gulf of Riga.

Poland.

Biological Investigations.

Material for the study of the fluctuations in the composition of the salmon shoals, with special regard to the age composition were collected.

The composition of food of small salmon and sea trout — smolts and one to three-year-olds — was studied. The preliminary results of these studies show that the Gammarids, Asellids and Phryganeids are used as the principal food.

Material for the study of parasites of salmonoid fishes was collected.

Marking Experiments.

During 1935, the following quantities of marked salmon, sea trout and brown trout were liberated:

a. 1-year-old salmon from the river Wilja		878 ind.
b. 2-year-old	— — - — —	600 —
c. 2-year-old	— — - Dalälven..	106 —
d. 1-year-old sea trout from the river Gauja		1312 —

All above-named individuals were previously cultivated in ponds and were liberated in the river Brda, a by-river to the Vistula.

313 two-year-old salmon from the river Wilja were liberated directly in the Baltic Sea, outside of the Peninsula of Hel.

515 one-year-old brown trout were liberated in the Gulf of Danzig, near the Polish shore.

During 1935, 82 individuals were recaptured; after determination of length and weight 47 of these were liberated again. One salmon (P. 9076) already mentioned in the last report as remaining in the river, was recaptured after 5 months for the second time and again in the river.

From the 1994 marked sea trout liberated in 1933 and 1934 in the river Wisłoka, a by-river to the Vistula, 40 individuals were recaptured in the Vistula and in the Baltic Sea.

Artificial Propagation.

In spring 1935 the following numbers of individuals were liberated in the by-rivers of the Vistula:

1. Tiny fry:	149,000	sea trout
	800,000	brown trout
2. 1-year-old:	400	sea trout
	22,400	brown trout.

In Autumn 1935 were placed in hatcheries:

450,000	eggs of sea trout
30,000	eggs of salmon
1,349,000	eggs of brown trout
330,000	eggs of lavaret
6,376,000	eggs of *Coregonus albula*.

Results of Fishery.

The total result of the fishery in the sea during 1935 was as follows:

Large salmon		Mielnica		Sea trout	
kg.	ind.	kg.	Ind.	kg.	Ind.
62,070	5,503	3,390	6,982	4,670	2,229

The total result was less than in good years. Very characteristic was the decreasing number of small salmon (mielnica) taken near the Polish coast. In later years the fishery for small salmon gives constantly decreasing results. The cause of this is probably connected, not only with possible fluctuations in the stock of mielnica, but chiefly with changes of the character of the fishery in Poland. The most profitable branch of fishery is the sprat-fishery giving good and safe results with simple methods. The fishermen are therefore more interested in the sprat-fishery than in the expensive and difficult fishery for mielnica, appearing near the coast at the same time as the sprat.

The run of sea trout in the Vistula was good and therefore more material for hatcheries was obtainable.

Free Port of Danzig.

For the first time it has been possible to obtain statistical figures concerning the salmon and sea trout fishery. Unfortunately the figures combine the quantity of both species without discrimination, but, as the fishery of Danzig is executed in the estuary of the Vistula, and in the river, the figures indicate chiefly the sea trout, the true salmon forming a small percentage only of the catches.

Under the name of "Speitzgen" corresponding to "mielnica", are indicated shoals of small salmon and sea trout. According to the indications of the Fisheries Office in Danzig more than 40 % of "Speitzgen" are sea trout. The weight of "Speitzgen" varies between 0.5 and 1.75 kg., averaging about 1 kg. The number of kg. thus corresponds roughly to the number of individuals.

The stock of sea trout consists of individuals of various dimensions and weight. The average composition is as follows: (see next page.)

Quantity of Salmon and Sea Trout caught in the Sea and in the lower part of the Vistula on the territory of the Free Port of Danzig, in 1933, 34 and 35, in kg.

	1933		1934		1935	
	Salmon and Sea Trout	"Speitzgen"	Salmon and Sea Trout	"Speitzgen"	Salmon and Sea Trout	"Speitzgen"
January	1,123.5	1.5	1,514	16	2,634.5	89.5
February	913.5	24.5	664.5	32.5	1,138.5	169.5
March	2,720.5	98.5	1,591	119	1,568	83
April	1,815	263	2,166	84	958.5	271.5
May	938	661	426	624	2,284	653
June	261	39	551	59	313	78
July	950	5	3,236.5	3.5	2,164	—
August	959.5	3.5	1,047.5	2.5	1,226	—
September	218.5	11.5	318.5	1.5	161.5	2.5
October	4,259	619	733	7	1,366.5	2,763
November	24,300	2,103	20,859	1,411	15,915	4,735
December	3,846	104	21,594	96	10,758	1,092
Together...	42,305	3,933.5	54,701	2,456	40,487.5	9,937
	46,238.5		57,157		50,425	

20 % of the stock consist of indiv. weighing 2—3.5 kg.
40 % - - — — - — — 4—5.5 -
20 % - - — — - — — 6—7.5 -
20 % - - — — - — — 8—10 and more kg.

The number of individuals caught can be estimated approximately as follows:

1933		1934		1935	
Salmon and S. Trout	Speitzgen	Salmon and S. Trout	Speitzgen	Salmon and S. Trout	Speitzgen
9,133	3,933	12,459	2,456	9,168	9,937

The majority of individuals of sea trout entering the Vistula and ascending to the spawning places is about 5 years old. The monthly catches show that the main run of the sea trout is in November and may extend to the first days of December. In the spring months there is a second run, by far less important than the autumnal one, but clearly appearing from the statistical figures. The nature of this second run is not sufficiently known. It is not impossible that the salmon (*S. salar*) and the sea trout enter the mouth of the Vistula at different periods of the year and that the shoals of salmon appear in the spring months. But it is also possible that the spring run is caused by a retardation of the migration of sea trout provoked by stormy weather and ice in the estuary and in the lower part of the river. M. Siedlecki.

Portugal.

1. During 1935 (from January till May) a scale-analysis of 30 salmon caught in the River Minho was made. As the scales have no marks of spawning, it is understood that the fish was making its first up-river journey. The age of the specimens examined varied from 4 to 6 years; these were large spring salmon, but their genital glands were not yet completely mature.

2. The "Estaçao Aquicola" liberated about 20,000 salmon in the rivers Minho, Lima and Cávade. All the salmon had previously been marked with silver rings with letters "E.A.Portugal". Several ways of marking the fish were tried, but it seems that the better results are to be expected from the marks fixed on the operculum; but a few marked fish, however, have been recaptured yet.

3. During the fishing season of 1935 (February 15th to June 30th) the yield of the fishery carried out by Portuguese fishermen in the estuary of the river Minho amounted to 350 specimens. During 1934 the yield was about the same, i. e. 382 fish.

4. No changes in Laws and Regulations.

Scotland.

1. Report on Year's Work.

1. Investigation of the life history of salmon and sea trout in certain districts by scales and measurements of the fish and by marked fish has been continued.

2. From the Tay scales of 2,329 salmon were examined and the feature was the small proportion, 9 %, of large spring fish (three winters in the sea) in the total in comparison with 21.7 % of this class found in 1930. In the whole the proportion of previously spawned fish was only 2.4 %. As previously found in this district, which is extensive and where some of the spawning grounds are about 100 miles apart, the type of area in which the parr feed is recorded on their scales by extreme variation in the growth rates. Those hatched in the higher and colder areas are of very much slower growth and of smaller final smolt size than are others which are hatched in the main river comparatively close to tidal waters.

3. On the west coast of Scotland, in the Island of Mull, where a sample of over 1,100 sea trout was obtained, the parr growth is poor although the smolt age is not high and the sea growth is also comparatively poor.

4. A detailed investigation has been made of the method of absorption of salmon and sea trout scales during the freshwater residence of the fish. After the preliminary difficulties of obtaining satisfactory sections of the material were overcome it was ascertained that the absorption was due to the phagocytic action of cells which are massed round the edge of the scales and which seem to be the same cells that originally deposited the scale material. On renewal of the scale growth after the kelt stage these cells seem to reverse again their action and lay down the new scale material.

5. The following papers have been published:

"The Sea Trout of Mull" — G. H. Nall, "Fisheries, Scotland, Salmon Fish., 1935, No. I".
"Sea Trout of the Montrose District — Part II, Growth on the Scales of Recaptured Fish" — G. H. Nall, "Fisheries, Scotland, Salmon Fish., 1935, No. II".
"Sea Trout of the Montrose District — Part III, The Migrations of Sea Trout" — G. H. Nall, "Fisheries, Scotland, Salmon Fish., 1935, No.III".
"Scale-Absorption in Salmon and Sea Trout" — M. Ian Crichton, "Fisheries, Scotland, Salmon Fish., 1935, No. IV".
"Salmon of the River Tay" — P. R. C. Macfarlane, "Fisheries, Scotland, Salmon Fish., 1935, No. V".

2. Salmon Hatching.

6. Only a few small hatcheries remain in operation and great difficulty was experienced in obtaining ova for these owing to continuous floods during the spawning season. It is probable that not more than two million salmon ova in all were hatched.

7. The commercial trout hatcheries remain in full operation and distributed several million fish in the form of eggs, fry, yearlings and two-year-olds.

Statistics of Catch.

8. The gross weight of the commercial catch of lmon and sea trout amounted to about 3,500,000 kg. nis weight, which is the only figure that can be btained, includes the weight of box and ice and the tt weight of fish was about 2,300,000 kg., of a value about £400,000.

Report on the Run of Salmon.

9. At the beginning of the season (December to bruary) there was a very good run of small spring h which, however, broke off seriously during the onth of March. In April and May it reappeared in od quantities and owing to the dry weather the ast nets made very satisfactory catches. From ecember to April there was also a good run of large ring salmon. In June and July grilse on most parts the coast were very plentiful but a few rivers for apparent reason were distinctly below the recent erage. On the whole 1935 was the best salmon hing season in Scotland for very many years, partly cause of the good run of fish and partly because e prevailing conditions of weather were in favour successful operation of the nets.

10. Sea trout also were in good supply but the naller (1+ winters) fish were rather below the erage.

Report on Marking Experiments.

11. Of over 2,500 sea trout marked in the Montrose ea on the east coast, 396 recaptures were made. me of these fish were found on the Scottish coast far as 175 miles from the place of marking and e was taken at the north end of the Dogger Bank er 300 miles from Montrose.

12. Scales were obtained from the majority of the captured sea trout marked at Montrose and these ve given valuable additional data on the validity age determination and length calculations from the ales. This series forms an important contribution to r knowledge in this respect.

13. Marking experiments with sea trout also continued in the North of Scotland where over 1000 fish were dealt with but so far results of this work have not been obtained.

6. Changes in Laws.

14. Nothing to report.

7. Marked Fish.

15. No salmon with hooks attached to them were taken but a grilse marked in Norway (near Bergen) in June was retaken on the east coast of Scotland 18 days later.

Spain.

No report received from Spain.

Sweden.

1. Salmon.

1. Scales of salmon and sea trout have been collected.

2. No statistics at present available.

3. a) A salmon, 108 cm., was caught at Rönnen in Skelderviken (the bight between Kattegat and the Sound), 25. V. 1935. The salmon had a hook which, according to Prof. WILLER, was of the Bornholm type. — The scale interpretation was: 3.3 + G1.

b) A salmon, weighing 2.2 kg., marked Oslo 23, was caught at Öllövstrand in Skelderviken 2. VIII. 1935. The salmon was according to Prof. DAHL marked at Rong near Bergen in Norway, 29. VI. 1935. No scale sample.

2. Sea Trout.

The researches about the sea trout of Avaan (in Stockholms län) have been continued.

The researches about the sea trout of Gotland have been finished and a report is printed (CHR. HESSLE, Gotlands havslaxöring).

Experiments are carried on with different methods of fertilization and of feeding the parr.